ISU Economic Report Series

Economics

10-1998

Dynamic Incentives, Occupational Mobility, and the American Dream

Maitreesh Ghatak
University of Chicago

Massimo Morelli
Iowa State University

Tomas Sjostrom
Pennsylvania State University - Great Valley

Dynamic Incentives, Occupational Mobility, and the American Dream

Maitreesh Ghatak, University of Chicago
Massimo Morelli, Iowa State University
Tomas Sjöström, Pennsylvania State University

Economic Report Series No. 49
October 1998

Dynamic Incentives, Occupational Mobility, and the American Dream *

MAITREESH GHATAK* MASSIMO MORELLI** TOMAS SJÖSTRÖM***

* *University of Chicago*

** *Iowa State University*

*** *Pennsylvania State University*

Abstract

This paper analyzes the incentive of individuals to work and save in order to overcome borrowing constraints and enter high return occupations involving set-up costs. It introduces an overlapping generations model of the principal-agent problem where all individuals are workers when young, but have a choice between becoming entrepreneurs or remaining workers when old. Bargaining power and incentive contracts in the principal-agent relationships are determined by market forces. The equilibrium displays occupational mobility and "market career concerns". The presence of an imperfect credit market mitigates the moral hazard problem in the labor market: young workers work hard in order to succeed and become "self-financed" principals. Reducing imperfections in the credit market leads to lower equilibrium rents to self-financed principals, which may reduce average effort and welfare because young workers work less hard.

Keywords: Moral Hazard, Overlapping Generations, Borrowing Costs, American Dream.

J.E.L. classification numbers: *D50, D82, J24, J41, J62*

*The first draft of this paper appeared as the third chapter of the second author's Ph.D. dissertation; a second and a third draft were circulated as CORE D.P. no. 9728 and Harvard W.P. no. 1812 respectively. We are grateful to Pranab Bardhan, Pierre-Andre Chiappori, Richard Eckhaus, Sven Feldman, Timothy Guinnane, Michael Kremer, Harvey Lapan, Robert Lucas, Eric Maskin, Herakles Polemarchakis, Canice Prendergast, Patrick Rey and Ilya Segal for helpful comments. We also thank seminar participants at Berkeley, Chicago, Chicago GSB, CORE, Harvard-MIT, Iowa State, Penn State, Venice, Washington(Seattle), Stanford GSB, Northwestern, Rochester, Chubu, Kobe, Osaka, Tokyo, Toulouse, Tilburg, E.S.E.M. 1997, and A.S.S.A. 1998 meetings. The usual disclaimer applies.

Corresponding address: Massimo Morelli, Dept. of Economics, Heady Hall 280C, Ames, IA 50011. E-mail: morelli@iastate.edu.

"The prudent, penniless beginner in the world labors for wages awhile, saves a surplus with which to buy tools or land for himself, then labors on his own account another while, and at length hires another new beginner to help him. This .. is the just, and generous, and prosperous system, which opens the way for all, gives hope to all, and energy, and progress, and improvement in condition to all." Abraham Lincoln, *Address before the Wisconsin State Agricultural Society,* 1859.

1 Introduction

The idea of the *American Dream* is closely associated with a dynamic market economy, where equality of opportunity coexists with inequality of outcomes, and where current hard work is motivated by expected rewards from future market opportunities. An important aspect of it is economic and occupational mobility. From the software industry in Silicon Valley, to small businesses set up by immigrants in modern day America, to agriculture and crafts going back in history, we see individuals driven by the belief that they can become rich through hard work, thrift and enterprise irrespective of their initial conditions. We analyze this phenomenon in a simple overlapping generations model of the principal-agent problem where agents (workers) work hard and save their wages in the current period to be able to become principals (entrepreneurs) and earn profits in the future. The relative supply of entrepreneurs and workers in a given period depends on the *incentives* of forward-looking workers to save or borrow to become entrepreneurs in the future. This incentive depends on the anticipated distribution of bargaining power in the labor market, which determines equilibrium labor contracts and hence the *ability* of workers to save. The prospect of earning entrepreneurial profits in the future influences the supply of effort of young workers. Imperfections in the credit market make self-financed entrepreneurship strictly more profitable than bank-financed entrepreneurship in equilibrium. Hence young workers want to save their current wages to become entrepreneurs in the future. Therefore they work harder than they would if they were offered the same labor contract as in the standard static principal-agent setting.

Our emphasis on deliberate actions of individuals who have little wealth to work extra hard and save to overcome borrowing constraints, and the resulting occupational mobility is in sharp contrast with the view that credit market imperfections may lead to *poverty traps*

(Banerjee and Newman, 1994). According to this view, if production involves set-up costs and credit markets are imperfect then individuals who start poor, stay poor because they cannot get a loan to enter into profitable occupations. As a result, an economy with many credit-constrained individuals will have lower average income because the poor will have to engage in less productive occupations. Moreover, the presence of many poor individuals in the economy will affect the equilibrium returns from various occupations in a way that will restrict upward mobility and perpetuate the state of affairs. In contrast, in our model credit market imperfections and the resulting rents in occupations involving set-up costs motivates the poor to work hard, save their wage income and enter these occupations.[1]

The description of the model is as follows: overlapping generations are born with no wealth, and live for two periods. In the first period of his life a young agent is matched with a entrepreneur who owns an asset, and works under an incentive contract whose terms are determined by the relative supply of entrepreneurs and workers. At the end of their first period these forward-looking workers decide whether to use their wages to invest in assets in order to become entrepreneurs in the next period, or whether to consume and remain workers in the future. Thus, an entrepreneur is someone who was a worker last period, and who invested in order to become entrepreneur. The credit market is imperfect, and borrowing money is costly.[2] This allows self-financed entrepreneurs to make strictly positive profits. Because the wage in each principal-agent relationship is a function of output, if self-financed entrepreneurs make positive profits then young workers work hard in order to get a high wage which they can invest to become entrepreneurs. This is what we call the *American*

[1] Interestingly, these two apparently conflicting views on economic mobility goes back well in history. The quotation above from Lincoln represents his position in favor of the theory of "free labor" (which corresponds to the current notion of the American Dream) as opposed to the "mud-sill" theory (which corresponds to what is currently referred to as a poverty trap view) advocated by many others, such as Tocqueville.

[2] If the credit market functions perfectly and everyone who wants to start a business can do so by borrowing from a bank, then the incentive compatibility constraints of young and old workers would look alike, and the only dynamic incentives left would be those emphasized in the career concerns literature, related to the presence of adverse selection. Because we only deal with moral hazard, abstracting from the adverse selection problem, the presence of perfect credit markets entails equal effort from young and old workers. Even in the other models of occupational choice in the literature the absence of credit market imperfections would eliminate all the action, since wealth distribution would be irrelevant in such a case.

Dream effect. Thus, market career concerns due to credit market imperfections can provide extra incentives, beyond what is provided *within* a contractual relationship, and reduce moral hazard in employment. This happens even though there is only one type of worker and no adverse selection. As is well known, if workers differ in terms of ability, then a young worker may work hard to try to convince the market that they are more able than they actually are. The American Dream effect provides a *different* reason for forward-looking workers to work hard.[3] Credit market imperfections reward those who are wealthy because they can capture opportunities which others cannot and *ex ante* this means there is much more reward for working hard and getting rich when one is young.

We show that under very general conditions a steady state equilibrium always exists. The equilibrium is unique if the discount factor is greater than one half. Depending on the parameters, the steady state equilibrium can be of different types. If the technology is capital-intensive then self-financed entrepreneurs will earn rents in equilibrium. Unsuccessful workers will either be indifferent between becoming bank-financed entrepreneurs and remaining workers next period, or strictly prefer the latter. The effort of young workers will reflect the American Dream effect. In this type of equilibrium, dynamic and across-markets incentives can outweigh the effects emphasized in the standard partial equilibrium principal-agent models. Reducing the imperfections on the credit market leads to higher wages to workers but lower rents to self-financed entrepreneurs. Since this reduces the shadow value of money for young workers who hope to earn rents as self-financed entrepreneurs, it reduces their effort. On the other hand, old workers without career concerns work harder, so the net effect of removing the imperfection is ambiguous. We show that welfare and average effort may *increase* as the degree of credit market imperfection goes up. This result is in the spirit of the theory of the second-best, namely, reducing the imperfections in only one market does not necessarily have positive welfare implications.[4] The second type of equilibrium appears if the technology is relatively labor intensive. In this equilibrium successful agents are indifferent

[3]For a discussion of career concerns in firms see Gibbons & Murphy (1992), Fama (1980), Holmström (1982) and Long & Shimomura (1997). It is of course possible for both effects to exist simultaneously. Adverse selection could make the credit market more imperfect by making banks unwilling to lend money to agents who were unsuccessful in the past.

[4]Lipsey & Lancaster (1956).

between being workers and self-financed entrepreneurs. All entrepreneurs are self-financed and earn no rents, and there is no American Dream effect.

The implications of our analysis in terms of incentives to work and save, and occupational mobility over the life cycle of an individual apply, in principle, to any economic environment where start-up costs for new enterprises combined with credit market imperfections lead to a high shadow value of wealth. The computer software industry in the US seems to fit this description. New ventures in Silicon Valley are typically started by engineers who were previously employed by other firms. In general there seems to be a very high occupational mobility and everyone is motivated to start their own companies (Saxenian, 1996).[5] Another prime example is small businesses which have always been an important part of the American economy and society. [6] These are often set up by immigrants to the US who come from all over the world to pursue the American Dream.[7] Indeed, the assumption of our model that everyone starts with little endowments, little history and as a result, shut off from the formal credit market applies particularly well to the situation faced by immigrants and explains why they work harder than others to succeed and overcome these borrowing constraints. In a recent study of nearly four hundred Korean business owners in Chicago and Los Angeles, Yoon (1997) found that most of his respondents came with a small amount of money, and started off in the US as a manual, service or sales worker, almost always in some existing Korean business. After accumulating capital mainly through personal savings, they frequently buy the business off from the existing owner.[8] Moreover, often starting with more labor intensive businesses (relying heavily on family labor), these worker-turned-entrepreneurs save, and

[5]Saxenian (1996) quotes from one of the interviews : "Out here we're always talking about who is doing what, what's succeeded. As result, everyone in Silicon Valley is motivated to do start-ups..". Jeff Kalb, CEO, MasPar Corp.

[6]About 4.2 million individuals operated small businesses on a full time basis in the US in the early eighties and employed about a tenth of all wage workers (Evans and Leighton, 1987). Going back in history, Alexis de Tocqueville (1835) noted that "..what astonishes me in the United States is not so much the marvellous grandeur of some undertakings as the innumerable multitude of small ones."

[7]First-generation immigrants own one out of every twelve companies according to the Census Bureau's most recent estimates in 1992. Most of these businesses are small businesses like grocery stores, dry cleaning, garment factories, and restaurants.

[8]Other sources of start-up capital were loans from social networks and rotating saving and credit associations.

move on to more capital intensive businesses.

The "agricultural ladder" is another example: "...a potential entrant began his career as a hired hand and through diligent work and wise spending, he accumulated sufficient funds to purchase a set of machinery. Subsequently the new entrant became a renter, then a part-owner of real estate, and finally the pinnacle of success was reached with full ownership of land and machinery" (Boehlje, 1973). Financial constraints are believed to be the key to this ladder phenomenon and to the life-cycle pattern observed in the size of the farm (Gale, 1994). Historically, a similar process was also observed in small-scale crafts and manufacturing. Poor farm households, often working as hired laborer in peak seasons, saved their meager earnings to buy tools and set up small scale labor-intensive rural industries. Well into the 19th century, in most European countries more value was created and more people were employed in small workshops, often selling their products to inter-regional and international markets (Kriedte et al, 1981). In a recent study of a group of independent small-scale craft enterprises in rural Scotland from the middle of the nineteenth century to the early decades of the twentieth century, Young (1995) found that most of these craft producers were former workers who used savings from previous wage employment for start-up capital. Very few of these businesses were able to secure credit from banks or merchants because they did not own assets that could be used as collateral.

These examples suggest that the economic forces described in this paper are important in the real world. In addition, there is direct evidence on the relevance of two crucial elements of our model: the role of credit market constraints in limiting entry to entrepreneurship, and the existence of inter-class mobility. Several empirical studies have shown that credit market constraints exist and are an important constraint for potential entrepreneurs. Evans and Leighton (1989) analyzed panel data from the National Longitudinal Survey of Young Men (NLS), which surveyed a sample of 4000 men between the ages of 14-24 in 1966 almost every year between 1966-81. They found that men with greater assets were more likely to switch into entrepreneurship from wage-employment, other things being equal.[9]

[9] Evans and Jovanovic (1989), using the same data set, found that entrepreneurs are limited to a capital stock no more than one and one-half times their wealth when starting a new venture. One could argue that individuals with greater ability are more likely to have both greater assets and the talent to become an entrepreneur. Blanchflower and Oswald (1998) studied similar panel data from the National Child Development

There is also much empirical evidence on the incidence of transition of individuals from worker to entrepreneur, as well as earnings mobility. Seven out of the top ten wealthiest Americans of all times in a list recently published in *The American Heritage* magazine (October 1998) started off as manual or clerical workers early in their life.[10] Quadrini (1997) used the well known Panel Study of Income Dynamics (PSID) data and found that from the sample of 5000 families the average *yearly* entrance rate to entrepreneurship from wage labor was 4% over the period 1973-92.[11]. Since both upward and downward mobility is observed in the data, a longer-term comparison gets rid of some of the year to year transitory movements.. This is provided by Evans and Leighton (1989) who found that in the sample of 4000 men mentioned above the fraction of self-employed rose from 3.9% in 1966 to 17.7% in 1981.[12] Finally, evidence also suggests that younger workers experience more upward mobility in their earnings than old workers (OECD, 1996).

Our model is related to recent dynamic equilibrium models of occupational choice and evolution of wealth distribution in the presence of agency costs (e.g., Banerjee and Newman, 1993) where individuals live for one period and bequests are the key to aggregate wealth distribution dynamics.[13] Our model shares with these models the focus on imperfect credit markets as key to entry into occupations that require set-up costs, and the equilibrium approach where returns to occupation are endogenously determined (and in particular, depend

Survey in the U.K. and found that men who received a gift or a bequest during the period when the surveys were conducted were more likely to start their own business. From this they concluded that wealthier individuals are more likely to become entrepreneurs because of liquidity constraints, and not because of differences in ability (see also Quadrini, 1997).

[10]This list includes John D. Rockefeller who started out as a bookkeeper; Andrew Carnegie, who came from a family of impoverished Scottish immigrants, and started off as telegrapher in the Pennsylvania Railroad; Stephen Girard, the shipping tycoon, who started as a cabin boy at fourteen; and Marshall Fields of the famous departmental store chain who started as an errand boy in a dry goods store.

[11]The entrance rate in year T is what percentage of the worker-families in year $T-1$ became entrepreneur-families in year T. The same PSID data provides evidence of strong earnings mobility (Gottschalk, 1997). For example, a person in the lowest quintile of earnings in 1974 moved to a higher quintile with probability 0.32 in the next year, and with probability 0.58 in 1991.

[12]Similar findings for the UK are obtained by Blanchflower and Oswald (1998). They analyzed the NCD panel data and found that the fraction of self-employed rose from 5.7% in 1981 to 14.2% in 1991.

[13]For related contributions see Newman (1992), Galor and Zeira (1993), Aghion and Bolton (1996), Piketty (1996), and Legros and Newman (1996).

on the proportion of wealth constrained agents). However, in our model all individuals are identical at birth with no inherited wealth and we analyze the dynamic, life-cycle aspects of work incentives, savings and occupational choice *within* an individual's lifetime. To isolate the dynamic incentives that constitute the American Dream, we focus on occupational mobility that results from conscious, forward-looking behavior on the part of an individual, rather than inter-generational mobility through bequests. Moreover, in the existing occupational choice literature contractual aspects in the labor market are underemphasized. For example, in Banerjee and Newman (1993) workers are always paid a fixed wage, and there is a monitoring technology that enables the entrepreneur to perfectly monitor the workers. In Aghion and Bolton (1997) and Piketty (1997) everyone is self-employed. In this respect our model is similar to the standard one-period principal-agent model (see Hart and Holmstrom, 1987), where the effort of the agent is subject to moral hazard. As a result optimal contracts have to satisfy incentive-compatibility and limited liability constraints. However, in standard principal-agent models, the bargaining power of the contracting parties and the occupational choice are exogenous. In contrast, a key feature of our model is endogenous occupational choice which means that every economic agent has a chance to decide, at some point in life, whether to become a principal or remain an agent.

Our paper is organized as follows. In section 2 we describe the overlapping generations model, analyze the characteristics of the financial and labor markets in this economy, and derive optimal contracts for young and old workers for alternative distributions of bargaining power. In section 3, we prove existence and uniqueness of steady-state equilibria of the model, and characterize alternative types of equilibria. We derive the equilibrium size of the entrepreneurial class, the corresponding equilibrium distribution of bargaining power, the equilibrium optimal labor contracts offered to old and young workers, and the net expected profits of self-financed and bank-financed entrepreneurs. These endogenous variables are functions of parameters representing tastes, production technology, and agency costs in the credit market. We consider the effect of a change in the degree of credit market imperfection on average effort and welfare. Section 4 contains some extensions.

2 The Model

We consider an overlapping generations model where risk-neutral individuals live for two periods. In any period the economy is composed of two generations, "young" and "old". We normalize the population size of each cohort to unity. Each individual is born without any wealth (there are no bequests). Each individual is endowed with one unit of labor in each period. Production requires three inputs: capital, labor and supervision. The entrepreneurial technology is fixed-coefficients type. An amount k invested in period t buys one unit of capital, and together with his or her labor endowment in period $t+1$ allows the person who bought the capital to become an "entrepreneur" (or principal) in period $t+1$. An entrepreneur can supervise at most $n \geq 1$ identical projects in period $t+1$, each operated by one agent called a "worker" using their labor endowments for period $t+1$. Investment is irreversible so once installed the capital cannot be consumed, and capital perishes completely after one period. One possible interpretation is that the investment k is a fee paid to acquire *human capital* which makes it possible to perform the supervisory role of an entrepreneur. We assume that a supervisor cannot be supervised and hence a very wealthy person can still run a firm with at most n workers. Again, this can be easily justified in the case of human capital.

The return from a project of a single worker, y, is $y_H = 1$ with probability e and $y_L = 0$ with probability $1-e$, where $e \in [0,1]$ is the amount of unobservable *effort* the worker puts. This is distinct from the one unit of labor they supply which is contractible. The cost to the worker of supplying effort level e is

$$c(e) = ce^2/2.$$

Project returns of the n workers working for the same entrepreneur are uncorrelated.

Each period starts with the birth of a new generation. Then the sequence of events is the following.

2.1 Time Line

Morning: In the morning entrepreneurs and workers are matched. The set of workers consists of all the newly born individuals together with those old individuals who did not invest the previous period; entrepreneurs are old individuals who invested in the previous period.[14] Matching is efficient in the sense that unmatched individuals can never be found on both sides of the market. An unemployed worker earns a subsistence income of 0. Because effort is unobservable, workers are given incentive contracts contingent on output. There is a limited liability constraint: income in any state of the world cannot be negative. Because of this restriction the agency problem cannot be solved costlessly.

A contract in period t is denoted $C_t = (e_t, h_t, l_t)$ where e_t is effort put in by the worker and h_t and l_t are his wages when output is high and low respectively. The age of a worker is public information, and young and old workers will in general receive different contracts. When it is necessary to distinguish young and old workers we denote the young (resp. old) worker's contract by $C_t^y = (e_t^y, h_t^y, l_t^y)$ (resp. $C_t^o = (e_t^o, h_t^o, l_t^o)$). The contract signed by an entrepreneur and a worker must be constrained efficient: it maximizes some weighted average of the expected utility of the contracting parties subject to the incentive-compatibility constraint (henceforth, ICC) and the limited liability constraint (henceforth, LLC). Note that as the current entrepreneur dies before the current worker gets old it is not possible to use long-term contracts.

The nature of the constrained efficient contract is determined by market forces of supply and demand. If the number of projects does not equal the number of workers, the equilibrium contract maximizes the payoff of the party on the short side, subject to the other party's reservation constraint. Thus, if there are more workers than projects, the contract maximizes the entrepreneur's payoff, subject to the worker getting at least zero. If there are more projects than workers, the contract maximizes the worker's payoff, subject to the entrepreneur getting at least as much as he could get if he switched occupation to become a worker. But Proposition 1 shows that neither of these situations is consistent with equilibrium, because individuals on the long side of the market must have made the wrong occupational choice. In equilibrium the number of workers must equal the number of projects. In addition, equilibrium labor contracts for young and old workers must be such that entrepreneurs are indifferent between hiring them, or else competition among entrepreneurs to attract the more desirable type would raise the payoff to that type.

[14]Agents who did not invest the previous day are not allowed to become entrepreneurs today by borrowing money and buying an *already existing* firm. This assumption is clearly justified in the case of human capital, in which case a transfer is not feasible.

Noon: Projects are carried out, uncertainty is resolved, outputs are publicly observed, and wages are paid according to the contracts signed in the morning. Bank-financed entrepreneurs repay the banks.

Evening: Old individuals consume everything they have and then die (there are no bequests). Young agents may pay k dollars to buy one unit of capital in order to become entrepreneurs in the next period. (Capital must be in place the evening before the day it is to be used.) If they do not invest they remain workers in the next period. A worker who receives a wage greater than k can self-finance his own investment. Otherwise he has to borrow from a bank if he wants to become an entrepreneur. Wealth which is not used to buy capital can be either consumed today or saved in a bank for consumption tomorrow. (As discussed in the next section, the interest rate equals the discount rate, so the worker is indifferent between the last two options).

2.2 Occupational Choice and Credit Markets

Let p_t denote the number of entrepreneurs at time t. The number of young workers is 1, the number of old workers is $1 - p_t$. The number of jobs (individual projects) is $p_t n$. To be an old worker in period t is worth $q_t u_t^o$, where q_t is the probability of getting a job at time t for an old worker and u_t^o is the payoff of old workers who are employed at time t.

Let A_t denote the expected profit of being an entrepreneur in period t gross of the cost of capital but net of wage payments. We derive A_t as a function of (h_t^o, l_t^o) and (h_t^y, l_t^y). An entrepreneur together with his workers is called a firm. Consider a firm with $\nu_t \leq n$ workers, of which ν_t^o are old and $\nu_t^y = \nu_t - \nu_t^o$ young. Let e_t^o and e_t^y denote the effort levels of old and young workers. Let $x_t^o \leq \nu_t^o$ and $x_t^y \leq \nu_t^y$ denote the number of old and young workers whose individual projects turn out to be successful. The firm's profit is

$$x_t^o(1 - h_t^o) - (\nu_t^o - x_t^o)l_t^o + x_t^y(1 - h_t^y) - (\nu_t^y - x_t^y)l_t^y.$$

Under our assumptions x_t^o and x_t^y are independently distributed binomial random variables with means $\nu_t^o e_t^o$ and $\nu_t^y e_t^y$. Therefore, the expected profit is

$$A_t = \nu_t^o\{e_t^o(1 - h_t^o) - (1 - e_t^o)l_t^o\} + \nu_t^y\{e_t^y(1 - h_t^y) - (1 - e_t^y)l_t^y\}.$$

Competition between entrepreneurs will ensure that they are indifferent between hiring young and old workers in equilibrium. Therefore A_t will *in equilibrium* not depend on the age-composition of a firm's labor force.

The expected payoff in period-t dollars for a successful worker who has wealth $w_t \geq k$, consumes the excess cash $w_t - k$ and invests k in order to become entrepreneur and earn A_{t+1} next period, is:

$$w_t - k + \delta A_{t+1}. \tag{1}$$

Let S_{t+1} denote the *net* profit from investing k. We obtain S_{t+1} by subtracting the expected payoff from remaining a worker, which is $w_t + \delta q_{t+1} u_{t+1}^o$, from the expression in Eq. (1). Thus,

$$S_{t+1} = \delta A_{t+1} - k - \delta q_{t+1} u_{t+1}^o. \tag{2}$$

Agents with insufficient cash may not find it advantageous to become entrepreneurs if bank-loans are expensive. Analogously to S_{t+1}, let B_{t+1} the *net* expected profit of an entrepreneur whose own wealth is $w_t < k$ and who borrows $b_t = k - w_t > 0$ from the bank. We must have $S_{t+1} \geq B_{t+1}$, with strict inequality holding if the credit market is imperfect. To derive B_{t+1} explicitly we need to describe the credit market.

In the credit market banks compete with one another as intermediaries between borrowers and depositors. There is free entry and each bank behaves competitively. At the same time they lend to a large enough pool of (uncorrelated) borrowers so that the bank carries no risk and only cares about the average rate of success of the whole pool. The banks must break even on average. Let ρ_t be the (gross) interest rate the bank pays to depositors the next evening on funds deposited today. We assume the supply of deposits is perfectly elastic: the credit market is an international market where this economy is small. This assumption simplifies the subsequent analysis significantly, and allows us to set $\rho_t = \frac{1}{\delta}$ where $\delta \in (0, 1]$ is the discount factor.[15]

The bank incurs a transaction cost $\gamma > 0$ for each of its loans.[16] In Section 4.1 we justify this by explicitly introducing moral hazard on the part of the entrepreneur; the bank can pay

[15] The assumption that the supply of credit is perfectly elastic implies that the cost of the credit market imperfections is completely borne by the borrower. If this assumption is dropped, then credit market imperfections would affect savings behavior, an effect which may be important in the real world.

[16] In equilibrium (see section 3) individuals either borrow k, or nothing and so our argument goes through

a monitoring cost γ to prevent the entrepreneur from shirking. For now we simply *assume* each loan incurs the cost γ (which does not depend on the *amount* of credit). Suppose a prospective entrepreneur borrows $b_t \leq k$ dollars from the bank at time t and provides the remaining $k - b_t$ dollars out of his own pocket. In return, the bank must get part of his period $t+1$ entrepreneurial income. The bank can observe the labor contracts and how many of the projects succeed (x^o_{t+1} and x^y_{t+1}). A financial contract specifies a state-contingent transfer $r(b_t, x^o_{t+1}, x^y_{t+1}, h^o_{t+1}, l^o_{t+1}, h^y_{t+1}, l^y_{t+1}) \leq x^o_{t+1} + x^y_{t+1}$ from the borrower to the bank. The capital invested in the firm dissipates completely after production takes place. The zero-profit condition in the banking sector says that the expected repayment per dollar of a loan equals the interest paid to depositors plus the monitoring cost γ:

$$\frac{1}{\delta}b_t + \gamma = E_t[r(b_t, x^o_{t+1}, x^y_{t+1}, h^o_{t+1}, l^o_{t+1}, h^y_{t+1}, l^y_{t+1})] \tag{3}$$

where $E_t[r(\cdot)]$ is the expected value of repayments to the bank over all possible realizations of $x^o_{t+1}, x^y_{t+1}, h^o_{t+1}, l^o_{t+1}, h^y_{t+1}$ and l^y_{t+1}.

The credit market contract must be constrained Pareto optimal: it maximizes the entrepreneur's payoff subject to the bank's zero profit constraint. In the labor market, the entrepreneur will be able to hire workers as long as they receive an expected utility equal to what they can get elsewhere. Constrained efficient labor contracts C^y_t and C^o_t maximize the entrepreneur's payoff subject to this constraint. Different credit market contracts will in general lead to different choices of C^y_t and C^o_t. For example, it can be shown that a debt contract reduces the relative attractiveness of the state where output is high to the entrepreneur, and distorts the labor contracts accordingly.[17] However, an equity contract has no such distortionary effects, and is constrained optimal. Under an equity contract the entrepreneur pays a certain fraction $\lambda(b_t)$ of the profits to the bank, and as is well known, a "tax on pure profits" does not distort the entrepreneur's incentives in any way. For simplicity and without loss of generality we therefore restrict attention to equity contracts.[18] The expected repayment to

even if the transaction cost of borrowing was some general non-decreasing function of the amount borrowed, b.

[17] Under a pure debt contract, the entrepreneur and his workers do not take the bank's profit into account when signing a contract. As a result, a debt contract is not constrained optimal on the credit market.

[18] This is not the only optimal contract. In particular, as the terms of the labor market contracts are

the bank is

$$E_t[r(b_t, x_{t+1}, h^o_{t+1}, l^o_{t+1}, h^y_{t+1}, l^y_{t+1})] = \lambda(b_t)A_{t+1}.$$

The expected net profit of a bank-financed entrepreneur is:

$$B_{t+1} \equiv \delta A_{t+1} - \delta E_t[r(b_t, x_{t+1}, h^o_{t+1}, l^o_{t+1}, h^y_{t+1}, l^y_{t+1})] - (w_t + \delta q_{t+1} u^o_{t+1}) \tag{4}$$

Notice that to obtain Eq. (4) we subtract the payoff from remaining a worker, assuming his wage was w_t. Using Eq. (3) and the fact that $b_t = k - w_t$ we finally obtain

$$B_{t+1} = \delta A_{t+1} - (k + \delta\gamma) - \delta q_{t+1} u^o_{t+1}. \tag{5}$$

Equations (2) and (5) imply that the net return from being a self-financed entrepreneur is strictly greater than that of being a bank-financed entrepreneur:

$$S_{t+1} - B_{t+1} = \delta\gamma > 0.$$

S_{t+1} must be non-negative in any equilibrium with production, because with $S_{t+1} < 0$ nobody would invest. Thus without loss of generality we assume $S_{t+1} \geq 0$, and it can be verified later that this will in fact hold in equilibrium.

Consider the evening of period t when a young worker with wealth w_t is about to make his occupational choice. With $S_{t+1} \geq 0$, if $w_t \geq k$ he will want to become entrepreneur (if $S_{t+1} = 0$ he is indifferent), and if he makes the optimal occupational choice then his payoff will be given by Eq. (1). Using Eq. (2), the value function for an worker who has wealth w_t is, therefore,

$$V_t(w_t) = \begin{cases} w_t + \delta q_{t+1} u^o_{t+1} + S_{t+1} & \text{if } w_t \geq k \\ w_t + \delta q_{t+1} u^o_{t+1} + \max\{0, B_{t+1}\} & \text{if } w_t < k \end{cases} \tag{6}$$

publicly observable, the bank can offer forcing credit contracts which tie down the terms of future labor market contracts (by making the entrepreneur surrender all his income if he signs any other contract with his workers). Because this does not improve on the equity contract, assuming equity contracts is without loss of generality.

2.3 Incentive Compatibility

Since there are no bequests, the wealth w_t of a young worker at the end of his first period is just the wage he receives. Either $w_t = h_t^y$ (if the project was successful), or $w_t = l_t^y$ (if the project failed). Hence, the *young worker's effort-choice* in period t is a solution of:

$$\max_{e_t^y}\left\{e_t^y V_t(h_t^y) + (1-e_t^y)V_t(l_t^y) - \frac{1}{2}c(e_t^y)^2\right\}.$$

subject to $0 \le e_t^y \le 1$. Thus,

$$e_t^y = \min\left\{1, \frac{V_t(h_t^y) - V_t(l_t^y)}{c}\right\} > 0$$

as long as $h_t^y > l_t^y$; and $e_t^y = 0$ otherwise. Notice that the value function derived in (6) can be discontinuous at $w_t = k$. Let $s_{t+1} \equiv S_{t+1} - \max\{0, B_{t+1}\}$ denote the expected *rent from self-financed entrepreneurship.* As $S_{t+1} \ge 0$ and $S_{t+1} - B_{t+1} = \gamma\delta$, $0 \le s_{t+1} \le \gamma\delta$. If $h_t^y > l_t^y \ge k$ or $k > h_t^y \ge l_t^y$ then

$$e_t^y = \min\left\{1, \frac{h_t^y - l_t^y}{c}\right\} \tag{7}$$

while if $h_t^y \ge k > l_t^y$ then

$$e_t^y = \min\left\{1, \frac{h_t^y - l_t^y + s_{t+1}}{c}\right\} \tag{8}$$

With an *old* worker the situation is different. As this is the last period of his life, he faces essentially a static decision problem, and his effort-choice in period t is a solution of:

$$\max_{e_t^o}\left\{e_t^o h_t^o + (1-e_t^o)l_t^o - \frac{1}{2}c(e_t^o)^2\right\}.$$

Thus

$$e_t^o = \min\left\{1, \frac{h_t^o - l_t^o}{c}\right\} > 0 \tag{9}$$

as long as $h_t^o > l_t^o$; and $e_t^o = 0$ otherwise.

A comparison of Eq. (8) and Eq. (9) reveals that if $h_t^y \ge k > l_t^y$ and $s_{t+1} > 0$ and if *the same* contract were offered to both old and young workers, then young workers would work strictly harder than old workers due to "career concerns" (assuming old workers do not already work at the maximal rate $e_t^o = 1$). An imperfect credit market raises the shadow price of a dollar of wages, and the young worker puts in more effort than he would otherwise, hoping to earn rents s_{t+1} from self-financed entrepreneurship. This is however a partial-equilibrium argument: in equilibrium young and old workers will get *different* contracts.[19]

From the incentive-compatibility constraints (7), (8) and (9) we see that the higher is l_t^i the (weakly) lower is e_t^i (for $i = o, y$). Since everyone is risk-neutral this implies l_t^i should be set as low as possible, and since workers have no wealth, it will be optimal to set $l_t^i = 0$. We do this from now on.

To avoid a multiplication of different cases, we make some simplifying assumptions. The first assumption guarantees interior solutions to the workers effort choice:

Assumption 1

$$c \geq 1$$
$$\delta\gamma \leq \min\{1, c-1\}.$$

Under Assumption 1, and with $l_t^i = 0$, the ICCs (7), (8) and (9) reduce to:

$$e_t^y = \begin{cases} \frac{h_t^y}{c} & \text{if } h_t^y < k \\ \frac{h_t^y + s_{t+1}}{c} & \text{if } h_t^y \geq k \end{cases}$$

$$e_t^o = \frac{h_t^o}{c}$$

where $s_{t+1} \in [0, \delta\gamma]$.

Furthermore, we assume borrowing costs are low enough to allow a bank-financed entrepreneur to make non-negative profits from n old workers at least when he has all the bargaining power and can offer the wage $h_t = \frac{1}{2}$. In the static model, this wage rate maximizes his profit from an old worker (see the proof of Proposition 1). Using the definition of B_{t+1}, this translates into the following assumption:

[19] Even if workers could use a lottery to pool in the extra money that remains after the successful workers have made their investments so that some failed workers could avoid going to the credit market, it is still strictly better to succeed because a worker wins the lottery with some low probability. More generally, whatever source of uncertainty or random shocks one adds to the model, the intuition is that you should still observe a discontinuity between the expected utility after a success and that after a failure. Therefore the general point about the relationship between the credit market imperfection and the incentives for young workers is robust to such changes.

Assumption 2

$$\delta\left(n\frac{1}{4c}-\frac{1}{8c}\right)\geq k+\gamma\delta$$

The left hand side of this inequality is the discounted profit from hiring n old workers at the efficiency wage, and the right hand side is the discounted cost of capital for a bank-financed entrepreneur.[20]

The final simplifying assumption is:

Assumption 3

$$k<\frac{1}{2}.$$

Assumption 3 turns out to be sufficient to guarantee the existence of equilibria where $h_t^y \geq k$ which makes complete self-financing possible. Although the possibility for successful agents to completely bypass the financial markets is present in many real world situations (see the examples discussed in the introduction), we use this assumption only to simplify the analysis. In general, one expects that private savings allow agents to *reduce* the cost of transacting on an imperfect credit market. Any such reduction will give agents dynamic incentives as discussed in this paper. Moreover, as mentioned in the introduction, worker-turned-entrepreneurs usually start off with more labor intensive businesses, save, and then move on to more and more capital intensive businesses.

3 Steady State Equilibria

In this section we drop the time-subscripts on all variables to simplify notation. We determine the steady state equilibrium values of the endogenous variables: (i) the size of the entrepreneurial class (p); (ii) the labor contracts offered to old and young workers ((e^o, l^o, h^o) and (e^y, l^y, h^y)); and (iii) the net expected profits for self-financed and bank-financed entrepreneurs (net of their opportunity cost of foregone income from being an old worker), S and B. Let us define a variable indicating the average effort level in the economy in a

[20]When n is large this assumption is satisfied even with a high cost of capital, k. What matters is the capital-labor ratio, $\frac{k}{n}$.

steady-state equilibrium:

$$Y \equiv \frac{(1-p)e^o + e^y}{2-p}.$$

In Section 3.1 we show that there is a unique value of p that is consistent with equilibrium in occupational choices of young agents. In Section 3.2 we derive a condition relating to the labor market: the wages of young and old workers have to make entrepreneurs indifferent between hiring one or the other. This allows us to write the net expected return of self-financed entrepreneurs, S, as functions of wages of only the old workers (or only the young workers). For a *given* S, we can derive the wages of young and old workers. From the incentive-compatibility constraints we can derive the corresponding effort levels. Thus we will characterize alternative steady-state equilibria in Section 3.3 simply by considering the possible values of S. In Section 3.4 we prove the existence of an equilibrium, which is unique if $\delta \geq 1/2$. Section 3.5 discusses how this equilibrium depends on the parameters of the model.

3.1 Equilibrium Size of the Entrepreneurial Class

If workers (resp. entrepreneurs) are expected to be scarce and in effect have all bargaining power in the next period, then every young worker will want to become a worker (resp. entrepreneur), but then workers (resp. entrepreneurs) will not be scarce in the next period. Thus there must be full employment in the steady state.

Proposition 1 *Under Assumption 2, in any steady state equilibrium the number of workers equals the number of projects (full employment). The number of entrepreneurs is* $p = \frac{2}{1+n}$.

Proof. If workers are in short supply, competition for workers guarantees that each entrepreneur receives his reservation payoff, which is the payoff he could get by switching to becoming a worker. In this case the entrepreneur does not recoup the investment k, so he must have made the wrong occupational choice.

If entrepreneurs are on the short side of the market, then labor contracts maximize the entrepreneur's payoff subject to the worker getting at least zero. The contract offered to an old worker solves

$$\max_{\{e^o, h^o\}} e^o(1-h^o)$$

subject to $0 \leq h^o \leq 1$ and $e^o = \frac{h^o}{c}$. The solution is $h^o = \frac{1}{2}$ and $e^o = \frac{1}{2c}$ and the old worker's expected utility is

$$e^o h^o - \frac{1}{2}c(e^o)^2 = \frac{1}{8c} > 0.$$

The entrepreneur's expected profit from this single project is $\frac{1}{4c}$, the same as in a purely static model (assuming the entrepreneur has all the bargaining power there). Clearly the profit from hiring a young worker is never smaller than this, so the entrepreneur earns at least $\frac{1}{4c}$ on each project (gross of the cost of capital). Assumption 2 implies that it is strictly better to be a bank-financed entrepreneur than to be an old worker, so every old individual must be an entrepreneur. Since each entrepreneur can hire $n \geq 1$ workers, and there is only one young person to be hired, this contradicts the assumption that entrepreneurs are on the short-side of the market.

Thus the number of projects, pn, equals the number of workers, $2 - p$, or $p = 2/(1+n)$. **Q.E.D.**

If $A2$ is violated (for example, if γ is large) then in equilibrium there will be no bank-financed entrepreneurs. In this case only successful young workers will become entrepreneurs and we will have $p = e^y < \frac{2}{1+n}$. There will be excess supply of workers, and some old workers will be unemployed in equilibrium.

3.2 Equilibrium Wages

Assuming $n > 1$, we have $p = \frac{2}{1+n} < 1$ in equilibrium, and the labor market consists of $1 - p > 0$ old workers and 1 young workers. Competition among entrepreneurs guarantees that entrepreneurs are indifferent between hiring young and old workers. From the incentive-compatibility constraints $h^o = ce^o$ and $h^y = ce^y - s$, so

$$e^y(1 - ce^y + s) = e^o(1 - ce^o). \qquad (10)$$

Since young workers are (weakly) more productive than old workers for the same wage, their wages are bid up by entrepreneurs. Thus, in equilibrium the wages (and from ICC, the effort levels) of young workers are (weakly) higher than those of old workers.

Lemma 1 *Assume $n > 1$ and Assumption 2. In any steady-state equilibrium the optimal labor contract satisfies*

$$(i)\ \ell^o = \ell^y = 0$$

$$(ii)\ h^o \geq \frac{1}{2}$$

$$(iii)\ h^y \geq \begin{cases} \frac{1}{2} & if\ \frac{1-s}{2} < k \\ \frac{1-s}{2} & if\ \frac{1-s}{2} \geq k \end{cases}$$

$$(iv)\ h^y \geq h^o,\ and\ h^y > h^o\ if\ s > 0$$

$$(v)\ e^y \geq e^o,\ and\ e^y > e^o\ if\ s > 0$$

Proof. We have already established (i). Consider (ii) and (iii). If the entrepreneurs could make take-it-or-leave it offers, they would offer old workers the efficiency wage $h^o = 1/2$. The contract they offer to a young worker would solve

$$\max_{\{e^y,h^y\}} e^y(1 - h^y)$$

subject to $0 \leq h^y \leq 1$, and

$$e^y = \begin{cases} \frac{h^y}{c} & \text{if } h^y < k \\ \frac{h^y+s}{c} & \text{if } h^y \geq k \end{cases}$$

This yields

$$h^y = \begin{cases} \frac{1}{2} & \text{if } \frac{1-s}{2} < k \\ \frac{1-s}{2} & \text{if } \frac{1-s}{2} \geq k \end{cases}$$

$$e^y = \begin{cases} \frac{1}{2c} & \text{if } \frac{1-s}{2} < k \\ \frac{1+s}{2c} & \text{if } \frac{1-s}{2} \geq k \end{cases}$$

Notice that $\frac{1-s}{2} \geq \frac{1-\gamma\delta}{2} \geq 0$ by Assumption 1, so $h^y \geq 0$. The entrepreneur's expected profit from a young worker is $\frac{(1+s)^2}{4c}$ if $\frac{1-s}{2} \geq k$ and $\frac{1}{4c}$ if $\frac{1-s}{2} < k$.

Since these are the lowest wages consistent with constrained efficiency, this proves (ii) and (iii).

Consider (iv). In any steady-state equilibrium the entrepreneur is indifferent between hiring young and old workers. We can write (10) as

$$\frac{h^y}{c}(1 - h^y) + \frac{s}{c}(1 - h^y) = \frac{h^o}{c}(1 - h^o)$$

We already know that $\frac{1}{2} \leq h^o \leq 1$ and $\frac{1-s}{2} \leq h^y \leq 1$. Also, the left-hand side attains a maximum at $h^y = \frac{1-s}{2}$ and decreases monotonically for $h^y > \frac{1-s}{2}$. Similarly the right-hand side attains a maximum at $h^o = \frac{1}{2}$ and decreases monotonically for $h^o > \frac{1}{2}$. Now start with any $h^o \in [\frac{1}{2}, 1]$. If $h^y = h^o$ then the left-hand side is greater than the right-hand side. Since the two sides are monotonically decreasing in h^y and h^o in the respective intervals we must have $h^y > h^o$ to restore equality.

Consider (v). The *ICC*s of young and old workers are:

$$e^y = \frac{h^y}{c} + \frac{s}{c}$$

and

$$e^o = \frac{h^o}{c}.$$

Therefore $e^y > e^o$ for any $s > 0$ even if the wages were equal. Now $h^y > h^o$ for $s > 0$ implies that $e^y > e^o$ for $s > 0$. If $s = 0$ then of course $e^y = e^o$. **Q.E.D.**

In reality the wage schedule is often upward sloping, due to (1) learning by doing, and (2) incentive concerns internal to the firm. In the presence of these two elements, the American Dream effect should still lead to wage profiles that are flatter (i.e. less upward sloping) in economic activities that involve set-up costs and where occupational mobility is important.

3.3 Classification of Equilibria

Proposition 1 and Lemma 1 describe the characteristics common to *every* steady-state equilibrium of the model. As long as $n > 1$, we must have $B \leq 0$, or else everyone would want to become an entrepreneur, so $p = 1$ in contradiction of Proposition 1. (The case $n = 1$ is relegated to the Appendix). Similarly, if $S < 0$, it would never be profitable to be an entrepreneur, so $p = 0$, again in contradiction of Proposition 1 (recall $S - B = \gamma\delta$). This leaves three possibilities for steady-state equilibria:

I. $S > B = 0$;

II. $S > 0 > B$;

III. $S = 0 > B$.

Assumption 3 and Lemma 1 part (iii) imply $h^y \geq k$, so self-financing is possible in any equilibrium. Cases I and II display the American Dream effect ($S > 0$), and young workers are strictly more productive than old workers. In all three cases, $s = S - \max\{0, B\} = S$, and hence Eq. (10) can be rewritten as

$$e^y(1 - ce^y + S) = e^o(1 - ce^o) \tag{11}$$

By Lemma 1, $e^y \geq \frac{1+S}{2c}$ and $e^o \geq \frac{1}{2c}$. Upon differentiating (11) it is easily verified that (for given S) e^y is increasing in e^o.

Equation (11) implies that the net expected profit of a self-financed entrepreneur can be evaluated as if he hired only old workers:

$$S = \delta\left(ne^o(1 - ce^o) - c\frac{(e^o)^2}{2}\right) - k \tag{12}$$

The net expected profit of a bank-financed entrepreneur is $B = S - \gamma\delta$. We want to consider equation (12) as implicitly determining $e^o = e^o(S)$ as a function of S (we will show later that this function is well defined). It is easy to verify upon differentiation that $e^o(S)$ is decreasing in S since $n \geq 1$ and (by Lemma 1) $e^o \geq \frac{1}{2c}$. The higher the entrepreneur's expected net profit from hiring old workers, the lower will have to be their wages, and hence, from the ICC, the lower is e^o. Finally we want to determine $e^y = e^y(S)$ as a function of S by substituting $e^o = e^o(S)$ in (11).

Thus, we use (11) and (12) to solve for e^o and e^y (and implicitly h^o and h^y from the ICC) as functions of S. Equations (11) and (12) are quadratic equations in e^o and e^y. We will show there exist two real solutions. As the higher effort level is better for both entrepreneur and worker, it is the only relevant choice. Therefore, the functions $e^o(S)$ and $e^y(S)$ are well defined.

Lemma 2 *For any $S \in [0, \gamma\delta]$, there exist real numbers*

$$e^o = e^o(S) \equiv \frac{n + \sqrt{n^2 - 4c(n + \frac{1}{2})\frac{k+S}{\delta}}}{2c(n + \frac{1}{2})} \tag{13}$$

$$e^y = e^y(S) \equiv \frac{1 + S + \sqrt{(1 + S)^2 - 4ce^o(S)(1 - ce^o(S))}}{2c} \tag{14}$$

such that (11) and (12) are satisfied.

Proof. Consider the function

$$\pi(e) \equiv ne - (n + \frac{1}{2})ce^2$$

Then $\pi(0) = 0$ and $\pi(1) = -n(c-1) - \frac{1}{2}c < 0$ as $c \geq 1$. Also, as $c \geq 1$ and $n \geq 1$, $e = \frac{n}{n+\frac{1}{2}}\frac{1}{c} < 1$ satisfies $\pi(e) = 0$. Also, $\pi'(e) = n - 2(n+\frac{1}{2})ce$ and $\pi''(e) = -2(n+\frac{1}{2})c < 0$. Therefore

$$\arg\max_e \pi(e) = \frac{n}{n+\frac{1}{2}}\frac{1}{2c} > 0.$$

Now e^o must satisfy

$$\pi(e^o) = \frac{k+S}{\delta}$$

A necessary and sufficient condition for a real solution to this equation to exist is

$$\max_e \pi(e) = \pi(\frac{n}{n+\frac{1}{2}}\frac{1}{2c}) \geq \frac{k+S}{\delta}$$

or equivalently

$$\frac{n^2}{n+\frac{1}{2}}\frac{1}{4c} \geq \frac{k+S}{\delta}.$$

We must show that for all S such that $0 \leq S \leq \gamma\delta$,

$$n \geq 4c(1+\frac{1}{2n})\frac{k+S}{\delta} = \frac{2c}{n}\frac{k+S}{\delta} + 4c\frac{k+S}{\delta}.$$

Assumption 2 implies

$$n \geq \frac{1}{2} + 4c\left(\frac{k}{\delta} + \gamma\right).$$

Thus it is enough to show $\frac{1}{2} \geq \frac{2c}{n}(\frac{k}{\delta} + \gamma)$, or, equivalently, $n \geq 4c(\frac{k}{\delta} + \gamma)$. But this again follows from Assumption 2.

There are two values of e that satisfy $\pi(e) = \frac{k+S}{\delta}$, both positive and less than $\frac{n}{n+\frac{1}{2}}\frac{1}{c}$. The lower root can never be part of an equilibrium, since for the same profit for the entrepreneur the bigger root will give a higher wage to the worker. Thus the unique solution is the bigger root. It can be easily verified that the explicit form of e^o is given by (13). Substituting in the ICC we get:

$$h^o(S) = \frac{n + \sqrt{n^2 - 4c(n+\frac{1}{2})\frac{k+S}{\delta}}}{2(n+\frac{1}{2})}. \tag{15}$$

Next, from our definitions and equilibrium conditions $e^y(S)$ solves:

$$e^y(S)(1 - ce^y(S) + S) = e^o(S)(1 - ce^o(S))$$

The explicit solution of $e^y(S)$ is (again taking the higher root) given by (14). Note that the maximum value of the expression $4ce^o(S)(1 - ce^o(S))$ is 1 which is attained at $e^o(S) = \frac{1}{2c}$. Therefore $e^y(S)$ is a real number if $(1 + S)^2 \geq 1$ which is satisfied for any $S \geq 0$. Correspondingly, we can find $h^y(S)$ from the *ICC* of young workers:

$$h^y(S) = \frac{1 - S + \sqrt{(1 + S)^2 - 4ce^o(S)(1 - ce^o(S))}}{2}$$

Q.E.D.

We now discuss the properties of each type of equilibrium.

3.3.1 American Dream Equilibria

These are steady-state equilibria where $S > 0$ and young workers work harder than old workers. There are two possibilities depending on whether or not bank-financed entrepreneurs exist or not in equilibrium.

Type I. The credit market is active, $B = 0$ and $S = \gamma\delta$. Denoting the effort levels in this equilibrium by $e^o(\gamma\delta) \equiv \widehat{e}$ and $e^y(\gamma\delta) \equiv e^*$, the average effort level in the economy is

$$Y = \frac{e^* + (1 - p)\widehat{e}}{2 - p}.$$

In a given cohort, e^* young workers succeed, and they all strictly prefer to become entrepreneurs (as $S > 0$). Unsuccessful workers are indifferent between becoming bank-financed entrepreneurs and old workers. As we need $p = 2/(1 + n)$ entrepreneurs from Proposition 1, clearly $2/(1 + n) \geq e^*$ is a necessary and sufficient condition for this equilibrium to exist. The number of bank-financed entrepreneurs in each generation is $2/(1 + n) - e^*$.

Type II. The credit market is inactive, $B < 0$ and $S \in (0, \gamma\delta)$. Successful workers become entrepreneurs but there are no bank-financed entrepreneurs. We have $e^y = e^y(S)$ and $e^o = e^o(S)$ uniquely determined by S (from Lemma 2). From Proposition 1, S must satisfy

$$e^y(S) = \frac{2}{1 + n}. \tag{16}$$

The average effort level in equilibrium is

$$Y = \frac{e^y(S) + (1 - e^y(S))e^o(S)}{2 - e^y(S)}.$$

3.3.2 Zero Profit Equilibrium

Here we have:

Type III. Profits are zero, and $B < S = 0$. No unsuccessful worker wants to invest, successful workers are indifferent, and young and old workers are equally productive and earn the same wages. Here $Y = e^o(0) = e^y(0) \equiv \tilde{e}$. The number of successful workers is $\tilde{e}$. Thus, the necessary and sufficient condition for this type of equilibrium to exist is $2/(1+n) \leq \tilde{e}$.

3.3.3 Summary

The following table summarizes the discussion of the three types of equilibria.

	S, B	e^y, e^o	$p, e^y(S)$
I	$S = \gamma\delta, B = 0$	$e^y = e^y(\gamma\delta) > e^o(\gamma\delta)$	$p = \frac{2}{1+n} \geq e^y(\gamma\delta)$
II	$0 < S < \gamma\delta, B < 0$	$e^y = e^y(S) > e^o(S)$	$p = \frac{2}{1+n} = e^y(S)$
III	$S = 0, B < 0$	$e^y = e^y(0) = \tilde{e}^o = e^o(0)$	$p = \frac{2}{1+n} \leq e^y(0)$

3.4 Existence and Uniqueness of Equilibrium

Let

$$\Phi(n) \equiv \frac{2}{(1+n)^2}[n(1+n-2c) - c].$$

Theorem 1 *Under Assumptions 1, 2 and 3, a steady state equilibrium exists. If $\Phi(n) \geq \frac{k}{\delta}$ then a zero profit equilibrium exists and if $\Phi(n) < \frac{k}{\delta}$ then an American Dream equilibrium exists.*

Proof. In Figure 1 we have drawn the "supply schedule" for entrepreneurs. If $S = 0$, then there are $e^y(0) \equiv \tilde{e}$ successful workers who are indifferent between becoming entrepreneurs and old workers, so the supply schedule has a vertical element at $S = 0$ of height $\tilde{e}$. If $0 < S < \gamma\delta$ then all successful workers strictly prefer to become entrepreneurs, but no unsuccessful workers want to do so. The supply of entrepreneurs is therefore precisely $e^y(S)$. Finally, if $S = \gamma\delta$ then all $e^y(\gamma\delta) \equiv e^*$ successful workers strictly prefer to become entrepreneurs, and the $1 - e^*$ unsuccessful workers are indifferent. Thus the supply schedule has a vertical segment at $S = \gamma\delta$, from e^* to 1. From (14) we see that $e^y(S)$ is a continuous function of S. If S approaches zero from above then $e^y(S)$ approaches $\tilde{e}$, and if S approaches $\gamma\delta$ from below then $e^y(S)$ approaches e^*. Thus in the figure the "supply schedule" is a continuous curve from $(0,0)$ to $(\gamma\delta, 1)$. The equilibrium number of entrepreneurs is $p = 2/(1+n) \leq 1$ from Proposition 1. The horizontal line $p = 2/(1+n)$ must cross the supply schedule at least once, which implies the existence of an equilibrium.

A zero profit equilibrium (of type III) exists if and only if the horizontal line $p = 2/(1+n)$ crosses the left vertical segment of the supply schedule:

$$e^y(0) \equiv \tilde{e} \geq \frac{2}{1+n} \tag{17}$$

If (17) holds then there are enough successful workers when $S = 0$ to fill the necessary number of entrepreneurial positions. Recall that $\tilde{e}$ is defined by

$$n\tilde{e}(1 - c\tilde{e}) - c\tilde{e}^2/2 = \frac{k}{\delta}$$

The left hand side of this expression is decreasing in $\tilde{e}$ in the relevant region ($\tilde{e} \geq \frac{1}{2c}$) so Eq. (17) is equivalent to

$$np(1 - cp) - cp^2/2 \geq \frac{k}{\delta}$$

or,

$$\Phi(n) \geq \frac{k}{\delta}. \tag{18}$$

Notice that $\Phi(n)$ is monotonically increasing in n.

If (18) is violated, $e^y(0) < \frac{2}{1+n}$ and the horizontal line $p = \frac{2}{1+n}$ crosses the continuous supply schedule $e^y(S)$ at a point where $0 < S \leq \gamma\delta$, in which case an American Dream equilibrium (of type I or II) exists. Fig. 1 shows the case of an equilibrium with $0 < S^* < \gamma\delta$. **Q.E.D.**

The steady-state equilibrium of this economy can thus be conveniently characterized by equilibrium in the market for entrepreneurs which determines the return to self-financed entrepreneurship S.

We now consider the relationship between the rate of profit, S, and the effort of young and old workers.

Lemma 3 *Make Assumptions 1, 2, and 3. Then $e^o(S)$ is always decreasing in S. If there exists S' such that $e^y(S)$ is increasing for $S = S'$, then $e^y(S)$ is increasing for all $S \geq S'$.*

Proof. The function $e^o(S)$ satisfies

$$S = \delta[ne^o(S)(1 - ce^o(S)) - c\frac{(e^o(S))^2}{2}] - k \tag{19}$$

Differentiating totally with respect to S we have

$$\frac{\partial e^o(S)}{\partial S} = \frac{1}{\delta[n(1 - 2ce^o(S)) - ce^o(S)]} < 0 \tag{20}$$

where the inequality follows from

$$e^o(S) \geq \frac{1}{2c} > \frac{n}{n + \frac{1}{2}} \frac{1}{2c}$$

The function $e^y(S)$ is defined by the relationship

$$e^o(S)(1 - ce^o(S)) = e^y(S)(1 - ce^y(S) + S) \tag{21}$$

Differentiating totally with respect to S, and using (20) we get

$$\frac{\partial e^y(S)}{\partial S} = [e^y(S) - f(e^o(S))] \frac{1}{2ce^y(S) - (1 + S)}. \tag{22}$$

where

$$f(e) \equiv \frac{2ce - 1}{\delta n \left(\frac{2n+1}{n} ce - 1\right)} \tag{23}$$

Recall that the maximum value of the expression $4ce^o(S)(1 - ce^o(S))$ is 1 which is attained at $e^o(S) = \frac{1}{2c}$. At that value of $e^o(S)$, $S = \delta(\alpha\frac{1}{4c} - \frac{1}{8c}) - k \equiv \bar{S}$ from (12). We know that $\bar{S} \geq \gamma\delta$ by Assumption 2. From (14),

$$e^y(S) = \frac{1 + S + \sqrt{(1 + S)^2 - 4ce^o(S)(1 - ce^o(S))}}{2c}.$$

At $S = 0$, $4ce^o(S)(1 - ce^o(S)) < 1$ and so $e^y(S) > \frac{1}{2c}$. For $S \in (0, \bar{S})$,

$$e^y(S) > \frac{1 + S + \sqrt{(1 + S)^2 - 1}}{2c}$$

and for $S = \bar{S}$,

$$e^y(S) = \frac{1 + S + \sqrt{(1+S)^2 - 1}}{2c}.$$

Therefore, in the relevant interval $S \in [0, \gamma\delta]$ we have $e^y(S) > \frac{(1+S)}{2c}$. Hence we have

$$\frac{\partial e^y(S)}{\partial S} > 0 \quad \Leftrightarrow \quad e^y(S) - f(e^o(S)) > 0 \tag{24}$$

It is easy to verify that $f'(e) > 0$, so (20) implies $f(e^o(S))$ is monotonically *decreasing* in S. **Q.E.D.**

The intuition behind this result is the following. Equation (11) expresses the equilibrium condition that an entrepreneur must be indifferent between hiring a young worker and an old worker. That is, expected profit per young worker, $e^y(1 - ce^y) + e^y S$, should equal expected profit per old worker, $e^o(1 - ce^o)$. Now an increase in S will decrease h^o and e^o from (12). It will also increase the expected profits per young worker and old worker from (11). With old workers this can be realized only through a cut in wages. With young workers, there are two ways of realizing this. First, a cut in wages, h^y (corresponding to the term $e^y(1 - ce^y)$) and second, from the higher effort that young workers put in "for free" now, even if wages do not change (corresponding to the term $e^y S$). Obviously you cannot cut wages as much as you do for an old worker because then you will be making more money off young workers which is inconsistent with (11).

Start with $S = S_0$ and let S increase by ΔS. Suppose on balance effort of young workers goes up. Now start with a higher level of S, $S_1 > S_0$. Now the increase in profits from the worker working hard "for free" is higher than before. Accordingly, the need to increase profits via a cut in wages is lower than before. So e^y must still increase on balance.

Figures 1 to 3 characterize all the possible types of the supply function of entrepreneurs, $e^y(S)$, that are consistent with Lemma 3. In Figure 1 the American Dream effect dominates and $e^y(S)$ is always increasing in S. In Figure 2 the American Dream effect is so weak that $e^y(S)$ is decreasing in S for every interior value of S. Figure 3 illustrates the possibility that the American Dream effect is weak for small values of S, but for higher values of S the American Dream effect takes over. As Figures 2 and 3 show, Lemma 3 does not rule out the possibility of multiple equilibria. Generically, for the same value of p it is possible to have *three* equilibrium values of S, but not more than that. However, if $\delta > 1/2$ then the equilibrium is unique.

Theorem 2 *Under Assumptions 1, 2, and 3, if $\delta > 1/2$ then a* unique *equilibrium exists.*

Proof. Existence is guaranteed for any δ by Theorem 1. If the "supply schedule" $e^y(S)$ does not cross the horizontal line $p = 2/(1+n)$ at any $S > 0$, then clearly there is a unique equilibrium, which is of type III. Similarly, if it does not cross at any $S < \delta\gamma$ there is a unique equilibrium, which is of type I. So suppose instead a crossing occurs at some point $0 < S < \delta\gamma$. Let

$$S^* = \min\{S : S > 0 \text{ and } e^y(S) = 2/(1+n)\}$$

We claim

$$\left.\frac{\partial e^y(S)}{\partial S}\right|_{S=S^*} > 0$$

From (22), it suffices to show

$$e^y(S^*) - f(e^o(S^*)) > 0 \tag{25}$$

where f is defined by (23). Now $e^o(S^*) \le 1/c$, and f is increasing in e, so

$$f(e^o(S^*)) \le f(\frac{1}{c}) = \frac{1}{\delta\,(1+n)} < \frac{2}{1+n}$$

since $\delta > 1/2$. But $e^y(S^*) = 2/(1+n)$ by assumption, which proves (25). Thus, as we raise S from zero, the first time $e^y(S)$ crosses the horizontal line $p = 2/(1+n)$, $e^y(S)$ is upward sloping. By Lemma 3, $e^y(S) > 2/(1+n)$ for all $S > S^*$. Thus, if the situation is as in Fig. 1, there is a unique type II equilibrium. **Q.E.D.**

The intuition for why high values of δ guarantee uniqueness (see figure 1) can be obtained from (11) and (12): from the latter it is easy to check that for any given value of e^o, S is increasing in δ; then from (11) e^y must also increase. So the strength of the American Dream effect increases with δ. From the proof of Lemma 3 we can also obtain a sufficient condition for e^y to be *always* increasing in S: Suppose $\delta \ge \frac{2c}{n+1}$. Then

$$e^y(S) > \frac{1}{2c} > \frac{1}{\delta(n+1)} = f(\frac{1}{c})$$

so $\frac{\partial e^y(S)}{\partial S} > 0$ for all $S \in [0, \gamma\delta]$.

Theorem 2 gives a sufficient condition for uniqueness. Of course, even if $\delta < \frac{1}{2}$, the equilibrium may still be unique. If n is large (in particular, if $\Phi(n) \geq \frac{k}{\delta}$) then not many entrepreneurs are needed, and successful agents must be indifferent between being workers and self-financed entrepreneurs. As a result, a unique zero-profit equilibrium will result. Notice that from (11) and (12), e^y is increasing in n for given S. As a result, when n is raised the supply schedule of entrepreneurs $e^y(S)$ shifts upwards, and the demand schedule p shifts downwards. This makes a zero-profit equilibrium more likely.[21] Conversely, when n is small a unique American Dream equilibrium with an active credit market will result.[22]

For intermediate values of n, any of the three types of equilibrium can result. If in addition δ is low then the bargaining power effect dominates and it is possible for $e^y(S)$ to decrease with S. In such a situation multiple equilibria may exist (see Figures 2 and 3). If they do, then the type III equilibrium must be one of them, because the demand schedule for entrepreneurs ($p = \frac{2}{n+1}$) must intersect the supply schedule $e^y(S)$ at a point $S > 0$ where it is downward sloping, and a zero-profit equilibrium always exists when $e^y(0) \geq p$. Moreover, when there are multiple equilibria then the type III equilibrium must dominate the other two, since the other two involve $e^y(S) < e^y(0)$ and $e^o(S)$ is always decreasing in S. therefore, average effort is maximized at $S = 0$. This is not surprising since, as mentioned above, the situations where multiplicity is possible are related to a dominating bargaining power effect.

3.5 Credit Market Imperfections, Effort and Welfare

In the previous section we discussed conditions under which the American Dream effect causes the effort of young workers to be increasing in the profit rate of self-financed entrepreneurs. Since the profit rate of self-financed entrepreneurs is increasing in the degree of credit market imperfections (in an equilibrium with borrowing), this raises the possibility that average effort and welfare could be increasing in the degree of credit market imperfections. In this section we explore this possibility.

As a measure of welfare, consider the expected utility of a new-born agent in a given

[21] For example, since $e^y(0) \geq \frac{1}{2c}$, if $p = \frac{2}{n+1} \leq \frac{1}{2c}$, or, $n \geq 4c - 1$ then irrespective of other parameter values (so long as $A1 - A3$ are satisfied) a zero-profit equilbrium will result.

[22] For example, since $e^y(0) < \frac{1}{c}$, if $p = \frac{2}{n+1} \geq \frac{1}{c}$ or, $n \leq 2c - 1$, then, irrespective of other parameter values (so long as $A1 - A3$ are satisfied), an American Dream equilbrium will result.

steady-state equilibrium:

$$W = e^y(h^y + S + \delta q u^o) + (1 - e^y)\delta q u^o - \frac{1}{2}c(e^y)^2$$
$$= \frac{1}{2}c[(e^y)^2 + \delta(e^o)^2]$$

using $q = 1$, $u^o = e^o h^o - \frac{1}{2}c(e^o)^2 = \frac{1}{2}c(e^o)^2$ and $e^y = \frac{h^y+S}{c}$. Recall that average effort in a steady-state equilibrium is:

$$Y = \frac{1-p}{2-p}e^o + \frac{1}{2-p}e^y.$$

The following proposition provides a sufficient condition for welfare and average effort to increase with the degree of credit market imperfections: the increase in effort of young workers should exceed in absolute value the decrease in effort of old workers times the discount factor.

Proposition 2 *Consider an American Dream equilibrium of type I, satisfying Assumptions 1, 2, and 3. Suppose $\delta > \frac{1}{2}$ so that the equilibrium is unique. A marginal reduction in the degree of credit market imperfection reduces welfare and average effort if*

$$\frac{\partial e^y}{\partial \gamma} > \delta \left|\frac{\partial e^o}{\partial \gamma}\right|.$$

Proof. Since

$$\frac{\partial W}{\partial \gamma} = c[e^y \frac{\partial e^y}{\partial \gamma} + \delta e^o \frac{\partial e^o}{\partial \gamma}],$$

by Lemma 1, $e^y \geq e^o$ everywhere, and $\delta < 1$, the result follows. Since $Y = \frac{1-p}{2-p}e^o + \frac{1}{2-p}e^y$ and $p < 1$, a similar argument applies for $\frac{\partial Y}{\partial \gamma}$. **Q.E.D.**

The intuition behind the result that welfare may increase in the size of the credit market imperfection is related to the fact that we are assuming throughout that the set-up costs are low enough to allow successful agents to *avoid* paying the borrowing cost. This result is consistent with the general intuition that high penalties may be good in equilibrium if agents can avoid them by altering their behavior in a productive way. The fact that some agents (the unlucky ones) have to pay higher penalties is compensated by the lower probability of paying the penalty ensuing from higher effort. With high set-up costs everybody must borrow, at least a little bit, and this will, at least partly, offset the positive incentive effect of borrowing costs on welfare.

The following two numerical examples of American Dream equilibria of type I both display $\frac{\partial e^y}{\partial \gamma} > 0$, but the total effect on W is different.

3.5.1 Example 1

Suppose $n = 2$, $c = 1.1$, $k = 0.2$, and $\delta = 0.85$. Accordingly $p = 0.66$. Since $\delta > 1/2$ a unique equilibrium exists. As $k < \frac{1}{2}$ Assumption 3 is satisfied. Moreover, as $\delta \geq \frac{2c}{n+1} = 0.73$, it follows from a previous remark that $e^y(S)$ is always upward sloping. The first-best effort level is $\frac{1}{c} = 0.90$.

First suppose there are no credit market imperfections, $\gamma = 0$. These parameter values satisfy Assumptions 1 and 2. In fact we have assumed $\gamma > 0$ so far for clarity of exposition, but, it is clear that with $\gamma = 0$ there exists a unique equilibrium with zero profits for both bank- and self-financed entrepreneurs, $S = B = 0$.[23] The equilibrium values of the remaining endogenous variables are $e^o = e^y = 0.57$, $h^o = h^y = 0.63$, $Y = 0.57$ and $W = 0.34$. As before, p agents become entrepreneurs, but now both types are indifferent between becoming entrepreneurs and remaining workers, and it does not matter if the entrepreneurs were successful agents or not.[24]

Now suppose we introduce credit market imperfections by increasing γ to 0.01. The parameter values continue to satisfy Assumptions 1 and 2. Now the equilibrium profit rate of self-financed entrepreneurs is $S = 0.01$. The equilibrium values of the remaining endogenous variables are $e^o = 0.56, e^y = 0.59, h^o = 0.61, h^y = 0.64, Y = 0.58$ and $W = 0.34$. As $p > e^y$ some unsuccessful workers borrow and become entrepreneurs, incurring some borrowing costs. Effort of young workers has gone up, while that of old workers has gone down, and moreover the former effect dominates the latter so average effort and welfare have all gone up.

What is the "optimal" degree of credit market imperfections? As γ is increased from 0, average effort and welfare continue to rise until $\gamma = 0.08$; at that point the equilibrium value of e^y equals $p = 0.66$. Further increases in γ have no effect as the economy remains at an American Dream equilibrium of type II with no borrowing, so any $\gamma \geq 0.08$ is "optimal". For $\gamma = 0.08$, $S = 0.06$, and $e^o = 0.49, e^y = 0.66$, $h^o = 0.54, h^y = 0.65$, $Y = 0.61$ and $W = 0.35$. With $\gamma = 0.08$, transactions costs (in current dollars, $\delta\gamma$) are 34% of the start-up cost k. Average effort is increased by 7%, and welfare by 4%, relative to the case $\gamma = 0$.

[23] Moreover, as γ approaches zero, the equilibrium values of all variables approach the equilibrium values for $\gamma = 0$.

[24] Notice that if $\gamma = 0$ a zero-profit equilibrium occurs where p can even be greater than $e^y(0)$, whereas with $\gamma > 0$ a zero-profit equilibrium exists only if $p < e^y(0)$.

Thus, dynamic incentives embodied in the American Dream effect can be very strong and with multiple market imperfections, borrowing costs can improve overall efficiency. The next example shows that this is not always the case.

3.5.2 Example 2

Suppose $n = 4, c = 2.3, k = 0.2$, and $\delta = 0.85$. Accordingly $p = 0.4$. Everything else is as in Example 1, but we have increased c (which is a measure of agency costs), and in order to satisfy Assumption 2, we have increased n as well. Now $p = 0.4$ and the first-best effort level is 0.43.

Again, first consider a situation where there are no credit market imperfections, $\gamma = 0$. These parameter values satisfy Assumptions 1 and 2. Since credit markets are perfect, the equilibrium profit rate is $S = B = 0$. The equilibrium values of the remaining endogenous variables are $e^o = e^y = 0.31$, $h^o = h^y = 0.72$, $Y = 0.31$ and $W = 0.2$. Now, if γ increases from 0 to 0.14, Assumptions 1 and 2 continue to be satisfied but at $\gamma = 0.14$ the constraint imposed by Assumption 1 binds. Effort of young workers monotonically increase from 0.31 to 0.35 while that of old workers decrease from 0.31 to 0.21, as in the previous example. For all γ between 0 to 0.14, $e^y < p$ so the American Dream equilibrium of Type I prevails. However, the decrease in the effort of old workers dominates the increase in the effort level of young workers, resulting in *lower* average effort and welfare. Average effort falls to 0.30 and welfare to 0.19. Thus, even if $e^y(S)$ is increasing in S so that the American Dream effect is in operation, in this example it is not strong enough to offset the negative effect on effort of old workers caused by credit market imperfections.

4 Extensions and Generalizations

4.1 Endogenizing the Cost of Credit

So far we have assumed that the bank incurs the cost γ on each of its loans. Here we endogenize this cost in a way similar to Holmström and Tirole (1997). Suppose the probability that a project yields a high output depends on actions taken by the worker *and* the entrepreneur. More precisely, suppose the entrepreneur can "shirk" by taking an action which yields him a *private benefit* $M > 0$. If the entrepreneur does not shirk, the probability of success is e as before, where e is the worker's effort. However, if he takes the private benefit, then all his projects fail with probability one. Whether or not he shirks and receives the benefit is unobservable, *unless* he is monitored by the bank. Monitoring costs the bank γ, but makes it impossible for the entrepreneur to take his private benefit. A bank will never lend money if it thinks the entrepreneur will take the private benefit, because in this case the loan can never be repaid. The bank therefore refrains from monitoring only if it thinks the entrepreneur who is not monitored will not shirk.

It is clear that if M is very big, even self financed entrepreneurs would shirk, while if M is sufficiently small, bank-financed entrepreneurs would not shirk even if they are not monitored. We will show that for intermediate levels of M, the analysis of the previous sections remains valid. In addition, we show in section 4.1.2 that for high levels of M, a different kind of American Dream effect arises from *rationing in the credit market.*

4.1.1 American Dream with Endogenous Monitoring

The zero-profit condition (3) is modified in the following way:

$$\frac{1}{\delta}b_t + \mu = E_t[r(b_t, x_{t+1}, h^o_{t+1}, l^o_{t+1}, h^y_{t+1}, l^y_{t+1})] \tag{26}$$

where

$$\mu = \begin{cases} \gamma & \text{if the bank monitors} \\ 0 & \text{otherwise} \end{cases}$$

By the same argument as before, $B = S - \delta\mu$ and $p = 2/(1+n)$ in steady state.

Section 3 showed the existence of equilibrium under the *assumption* that banks monitor each loan at a cost γ. Assume for simplicity $\delta > 1/2$ so the equilibrium is unique. Let A denote the expected profit of an entrepreneur as determined by the equilibrium of Section 3. This remains an equilibrium with voluntary monitoring if and only if no bank would want to deviate by offering credit contracts with no monitoring. Such deviations can be profitable only if they would not induce the entrepreneur to take the private benefit.

Suppose such a deviation is possible. We can assume the deviation is such that the bank still makes zero profit, but the bank-financed entrepreneur is made better off. In this case, if he does *not* take his private benefit, his firm can still make a gross profit of A, but his expected repayment of the loan to the bank is only $\frac{k}{\delta}$. If he takes does take his private benefit, all his projects fail, and he will not pay anything to the bank; his payoff will be M. Thus, if he is not monitored the bank-financed entrepreneur will take the private benefit if and only if

$$M > A - \frac{k}{\delta} \tag{27}$$

Therefore, such a deviation by the bank is not possible if (27) holds. The self-financed entrepreneur (who is never monitored) has no loan to repay and is therefore less tempted to take the private benefit. He will *not* take the private benefit if and only if $M \leq A$. Therefore, the equilibrium found in Section 3 is still an equilibrium here, as long as $A - \frac{k}{\delta} < M \leq A$. This provides a justification for the analysis of the previous sections.

4.1.2 American Dream with Credit Rationing

Let us briefly discuss the case where the private benefit is so small that (27) is violated in the "equilibrium with monitoring" of Section 3. If banks are allowed not to monitor, then a contract without monitoring could then break the equilibrium. The entrepreneur could be asked to pay back only k/δ, and as (27) is violated he would not take the private benefit. In this case there exists instead an equilibrium *without* monitoring of bank-financed entrepreneurs. There are two possibilities. If

$$n\tilde{e}(1 - c\tilde{e}) - \frac{k}{\delta} \geq M \tag{28}$$

then there exists an equilibrium with $S = B = 0$. Each agent is indifferent between being entrepreneur and worker. The effort of both young and old is $\tilde{e} = e^o(0)$, and the profit gross of capital cost is $A = n\tilde{e}(1 - c\tilde{e})$. Unsuccessful workers can get bank-loans with no monitoring, and (28) implies that the private benefit M is small enough that the bank-financed entrepreneur voluntarily does not take the private benefit. The credit market has no frictions, there is no advantage in being self-financed, and no "American Dream".

The other and more interesting possibility is that (28) is violated. Say $S = S^*$ in the equilibrium of Section 3. By definition

$$S^* = \delta \left[ne^o(S^*)(1 - ce^o(S^*)) - c\frac{(e^o(S^*))^2}{2} \right] - k$$

We are assuming both (27) and (28) are violated at the equilibrium:

$$ne^o(0)(1 - ce^o(0)) - \frac{k}{\delta} < M \leq ne^o(S^*)(1 - ce^o(S^*)) - \frac{k}{\delta} \tag{29}$$

which implies $S^* \neq 0$, so $S^* > 0$. There are two cases.

Case A: the equilibrium found in Section 3 is of type I, $S^* = \delta\gamma$.

Since the equilibrium is unique, we must have $e^y(0), e^y(S^*) \leq \frac{2}{1+n}$. We will construct an equilibrium where the *credit market is active, but with rationing.*

By continuity of the expressions that appear in (29), and by the fact that $e^o(S)$ is decreasing in S (equation (20)), there exists $\bar{S}$ such that

$$0 < \bar{S} < S^* = \delta\gamma \tag{30}$$

$$e^o_*(S^*) < e^o(\bar{S}) < e^o_*(0) \tag{31}$$

$$ne^o(\bar{S})(1 - ce^o(\bar{S})) - \frac{k}{\delta} = M \tag{32}$$

From the fact that (27) and (28) are violated it follows that

$$ne^y(S^*)\left(1 - ce^y(S^*) + \frac{1 - \frac{2}{1+n}}{1 - e^y(S^*)}\bar{S}\right) \leq \frac{k}{\delta} + M \leq ne^y(0)\left(1 - ce^y(0) + \frac{1 - \frac{2}{1+n}}{1 - e^y(0)}\bar{S}\right)$$

By continuity there is $\bar{e}_y < \frac{2}{1+n}$ between $e^y(0)$ and $e^y(S^*)$ such that

$$n\bar{e}^y\left(1 - c\bar{e}^y + \varepsilon\bar{S}\right) = \frac{k}{\delta} + M \tag{33}$$

where

$$0 < \varepsilon \equiv \frac{1 - \frac{2}{1+n}}{1 - \bar{e}^y} < 1$$

Consider the following equilibrium. Young workers are paid $\bar{h}^y = c\bar{e}^y - \varepsilon\bar{S}$ if they succeed and zero otherwise. Their effort level is $\bar{e}^y$. Old workers are paid $\bar{h}^o = c\bar{e}^o$ if they succeed and zero otherwise. Their effort is $\bar{e}^o$. Then (32) and (33) imply hiring a young or an old worker is equally profitable. All successful young workers become entrepreneurs. The bank does not monitor and makes zero profit, so the expected repayment for a bank-financed entrepreneur is k/δ. This means the bank-financed and self-financed entrepreneurs make the same net profit, which is $\bar{S}$ by construction. The left hand side of (32) is the bank-financed entrepreneur's expected income if he does not take the private benefit M. Thus, (32) implies that the bank financed entrepreneur is indifferent between taking and not taking the private benefit: we assume he does not take it. As $\bar{S} > 0$, all unsuccessful workers strictly want to become entrepreneurs, but they are *rationed* as in Stiglitz and Weiss (1981). Only a fraction

$$\frac{\frac{2}{1+n} - \bar{e}^y}{1 - \bar{e}^y} = 1 - \varepsilon$$

of the $1 - \bar{e}^y$ unsuccessful workers obtain bank loans. This guarantees that the total number of entrepreneurs is $\frac{2}{1+n}$.

Given their wages, old workers maximize utility by setting effort $\bar{e}^o = \bar{h}^o/c$. Consider the young worker. The value of succeeding to him is $\bar{h}^y + \varepsilon\bar{S}$, because he will become an entrepreneur and earn $\bar{S}$ tomorrow for sure, while if he had failed he would only have become entrepreneur with probability $1-\varepsilon$. The probability ε of being rationed on the credit market if he fails gives an extra incentive for the young agent to work hard: he maximizes utility by setting effort equal to

$$\bar{e}^y = \frac{\bar{h}^y + \varepsilon\bar{S}}{c} \tag{34}$$

We need to check that this is an equilibrium on the credit market. Banks make zero profit. In an equilibrium with rationing it must not be feasible for a rationed agent to offer to pay a higher interest rate in return for a loan. In fact, by (32) bank financed entrepreneurs are indifferent between taking or not taking the private benefit when the expected repayment is k/δ. If an agent offers to pay back more than k/δ, the bank would know that he would take his private benefit, so the bank would have to monitor. But $\bar{S} < \delta\gamma$ implies there is no profitable contract with monitoring. Hence there is equilibrium on the credit market. This completes the analysis. Notice that the rationing on the credit market implies an American Dream effect of a different kind than the one analyzed in the earlier sections.

Case B: the equilibrium found in Section 3 is of type II, $0 < S^* < \delta\gamma$, and $e^y(S^*) = \frac{2}{1+n}$.

In this case, with endogenous monitoring, there exists an equilibrium where the wages, profits, and effort levels are the same as with exogenous monitoring. Only successful workers become entrepreneurs, and they make profit S^*. Unsuccessful workers do not get loans with monitoring, because S^* is smaller than the monitoring cost. The only thing to be checked is that unsuccessful workers cannot get loans without monitoring. However, as (27) is violated, a bank-financed entrepreneur who is not monitored would take the private benefit. Thus, the equilibrium is essentially the same, whether or not monitoring is endogenous, and there is an "American Dream" effect.

4.2 Allowing for Bonds

So far we have assumed that successful workers use their success wage either to buy capital or for consumption. We have ruled out the possibility of saving the wage, remaining a worker, and posting a bond the next period. In terms of our model, this means that now the wage of the worker when he fails, l, could be negative. If γ is small, then allowing bonds can make it desirable (in terms of efficiency) to have rich people as workers and poor people as entrepreneurs. The entrepreneur would borrow money to invest k, but a rich worker becomes the residual claimant.

Since bonds are efficiency enhancing, entrepreneurs would compete to hire workers who can post bonds, which benefits the rich worker. This makes the opportunity cost of not being an old worker for a successful agent (who could post a bond) strictly greater than the opportunity cost for an unsuccessful agent (who could not post a bond). Again let S (resp. B) denote net profit of being a self-financed entrepreneur (resp. bank-financed entrepreneur). If γ is large enough, then $S \geq B$ and the analysis of Section 3 would be essentially unchanged. Thus, we will consider only the case where γ is small enough to actually make $S < B$ a possibility.[25] Denote by U the payoff of being an old worker with a bond. As before, the old worker with no money receives $\frac{c}{2}(e^o)^2$. By the above argument, $\frac{c}{2}(e^o)^2 < U$. Assuming banks do monitor borrowers we have

$$S - B = \delta\gamma - (U - \frac{c}{2}(e^o)^2) < \delta\gamma.$$

If $S - B < 0$ then unsuccessful agents are more willing to become entrepreneurs than successful agents. The relevant "supply schedule for entrepreneurs" is then $1 - e^y(B)$, where B is the net profit from becoming a bank- financed entrepreneur. See Figure 4. The supply schedule is vertical along the vertical axis below $1 - e^y(0)$ and vertical above $1 - e^y(\bar{B})$, where $\bar{B}$ is determined below. The analysis is similar to Section 3. We shall summarize the different

[25] $S < B$ would of course also occur whenever the private benefits are such that banks do not need to monitor.

possibilities. We have three kinds of equilibria. In *all* these equilibria, dynamic incentives lead to $e^y > e^o$, because the possibility of succeeding is relatively more attractive for young workers, who can save the money and become old workers with bonds. So the American Dream survives.

Case 1. If n is large, the equilibrium has $S < B = 0$. The condition $B = 0$ determines e^o (and h^o through the ICC); the condition that any entrepreneur must be indifferent among workers determines (together with the ICCs) also e^y, h^y, $e^{o,b}$ and $h^{o,b}$, $l^{o,b}$ (where superscript b denotes that the worker has posted a bond). The horizontal line $p = 2/(1+n)$ crosses the supply of bank-financed entrepreneurs at the lower portion of the graph, and $B = 0$; we need $1 - e^y(0) \geq p$. It is equally good for an unsuccessful agent to remain a worker or become a bank-financed entrepreneur, while being a worker with a bond is strictly better than any of those possibilities; therefore $h^y > h^o$ and $e^y > e^o$. In fact, $e^y = \frac{h^y+u}{c}$, where $u = U - \frac{c}{2}(e^o)^2 > 0$.

Case 2. If n is small, the economy needs both self-financed and bank-financed entrepreneurs, and $0 = S < B$. The condition $S = 0$ and the fact that entrepreneurs must be indifferent between hiring a worker of one type or another determines the endogenous variables. The bank financed entrepreneurs payoff is at its maximum value

$$\bar{B} = -\delta\gamma + [U - \frac{c}{2}(e^o)^2].$$

where e^o is calculated from $S = 0$. For consistency, $p = 2/(1+n) \geq 1 - e^y(\bar{B})$.

Case 3. $S < 0 < B < \bar{B}$, $p = 1 - e^y(B)$. This corresponds to the type II equilibrium of Section 3.

5 Concluding Remarks

This paper introduces an overlapping generations model of the principal-agent problem and characterizes the dynamic and across-markets incentives associated with the American Dream (the "market career concerns"). We study the impact of future career possibilities and market imperfections on individual behavior and aggregate outcomes. Any market economy displays inequality of earnings across occupations, but these differences may be acceptable as long as agents have similar opportunities *ex ante*. Other authors have analyzed the consequences of different initial conditions and heterogeneous abilities, whereas our paper focuses on the incentives, choices, and earnings of *ex ante* identical agents. In our model, the effort of young agents is higher than in the corresponding static model as long as the equilibrium profits for self financed entrepreneurs are positive. If agents are patient enough, then higher profits lead to higher effort for young workers, whereas the standard distributional conflict arises only when agents are not patient enough.

Appendix

The case $n = 1$ has special properties. From Proposition 1, $p = \frac{2}{1+n} = 1$, so every agent must become entrepreneur when old. As $e^y < 1$ we need the credit market to be active: $B \geq 0$. Here there can never be over-supply of entrepreneurs, so $B > 0$ is possible. This introduces an *indeterminacy* in the model, for a whole range of wages are compatible with $B \geq 0$. Notice that $S > B \geq 0$ implies the American Dream effect exists.

Proposition 3 *If $n = 1$ then there exists a steady-state equilibrium with $p = 1$ and $S > B \geq 0$. The workforce consists of young workers only, but their wage rate is not uniquely determined. There is a continuum of wages that are consistent with equilibrium.*

Proof. As argued, we need to check that $B \geq 0$ is feasible. If the entrepreneur could choose the wage h^y then he would set it at $\frac{1-\gamma\delta}{2}$ which would maximize his profits, $\frac{h^y+\delta\gamma}{c}(1-h^y)$. Then $h^y = \frac{1-\delta\gamma}{2}$ is a possible equilibrium wage if

$$B = \frac{h^y + \delta\gamma}{c}(1 - h^y) - \gamma - \frac{k}{\delta} \geq 0$$

or,

$$\frac{(1+\delta\gamma)^2}{4c} > \gamma + \frac{k}{\delta}$$

This condition is satisfied by assumption 2 as

$$\frac{(1+\delta\gamma)^2}{4c} > \frac{1}{4c} > \frac{n-\frac{1}{2}}{4c}$$

when $n = 1$. The effort level corresponding to this wage rate is

$$e^y = \frac{1+\delta\gamma}{2c}$$

Notice that this is not the only possible equilibrium. In fact there exists a continuum of equilibria when $n = 1$. The maximum wage consistent with steady-state equilibrium is h^y that satisfies:

$$B = \frac{h^y + \delta\gamma}{c}(1 - h^y) - (\gamma + \frac{k}{\delta}) = 0$$

or,

$$(h^y)^2 - (1-\delta\gamma)h^y + (\frac{k}{\delta} + \gamma)c - \delta\gamma = 0$$

or,

$$h^y = \frac{(1-\delta\gamma)}{2} + \frac{1}{2}\sqrt{(1+\delta\gamma)^2 - 4c(\frac{k}{\delta}+\gamma)}$$

Correspondingly,

$$e^y = \frac{h^y + \delta\gamma}{c} = \frac{(1+\delta\gamma)}{2c} + \frac{1}{2c}\sqrt{(1+\delta\gamma)^2 - 4c(\frac{k}{\delta}+\gamma)}.$$

Therefore

$$h^y \in [\frac{(1-\delta\gamma)}{2}, \frac{(1-\delta\gamma)}{2} + \frac{1}{2}\sqrt{(1+\delta\gamma)^2 - 4c(\frac{k}{\delta}+\gamma)}].$$

Note that

$$\frac{(1-\delta\gamma)}{2} + \frac{1}{2}\sqrt{(1+\delta\gamma)^2 - 4c(\frac{k}{\delta}+\gamma)} < \frac{(1-\delta\gamma)}{2} + \frac{1}{2}\sqrt{(1+\delta\gamma)^2} = 1.$$

Q.E.D.

References

[1] Aghion P. and P. Bolton [1997]: "A Trickle-down Theory of Growth and Development". *Review of Economic Studies,* Vol. 64, p 151-172

[2] Azariadis, C. and B. Smith [1993]: "Adverse Selection in the Overlapping Generations Model: The Case of Pure Exchange", *Journal of Economic Theory,* Vol. 60, 277-305.

[3] Banerjee, A. and A. Newman [1993]: "Occupational choice and the Process of Development", *Journal of Political Economy.*

[4] Banerjee, A. and A. Newman [1994]: "Poverty, Incentives and Development", *American Economic Review.*

[5] Blanchflower, D.G. and A.J. Oswald [1998] : "What makes an entrepreneur?" *Journal of Labor Economics.*

[6] Boehlje, M., [1973] : "The Entry-Growth-Exit Processes in Agriculture", *Southern Journal of Agricultural Economics.*

[7] Evans, D. and B. Jovanovic [1989] : "An Estimated Model of Entrepreneurial Choice under Liquidity Constraints". *Journal of Political Economy.*

[8] Evans, D. and L. Leighton [1989]: "Some Empirical Aspects About Entrepreneurship". *American Economic Review.*

[9] Fama, E. [1980]: "Agency problems and the Theory of the Firm", *Journal of Political Economy* 88:288-307

[10] Gale, H. F., Jr. [1994] : "Longitudinal Analysis of Farm Size over the Farmer's Life Cycle", *Review of Agricultural Economics.*

[11] Galor, O. and J. Zeira [1993]: "Income Distribution and Macroeconomics", *Review of Economic Studies* 60.

[12] Gibbons, R. and K. Murphy [1992]: "Optimal Incentive Contracts in the Presence of Career Concerns", *Journal of Political Economy*, Vol. 100, No. 3.

[13] Hart, O. and B. Holmstrom [1987]: "The Theory of Contracts". In *Advances in Economic Theory*, (ed.) T. Bewley, Cambridge University Press.

[14] Holmström B. [1982]: "Managerial Incentive Problems - A Dynamic Perspective". In *Essays in Economics and Management in the honor of Lars Wahlbeck.* Helsinki: Swedish school of Economics

[15] Holmström B. and J. Tirole [1997]: "Financial Intermediation, Loanable Funds, and the Real Sector" *Quarterly Journal of Economics* 112 (3): 663-691.

[16] Kriedte, P., H. Medick, and J. Schlumbohm [1981] : *Industrialization before Industrialization : Rural Industry in the Genesis of Capitalism.* Cambridge University Press.

[17] Legros, P. and A. Newman [1996]: "Wealth Effects, Distribution and the Theory of the Firm", *Journal of Economic Theory.*

[18] Lipsey, R. and K. Lancaster [1956]: "The General Theory of the Second Best", *Review of Economic Studies*, 24 : 11-32.

[19] Long, N. V. and K. Shimomura [1997]: "Education, Moral Hazard, and Endogenous Growth", Mimeo McGill University

[12] Newman, A. [1992]: "The Capital Market, Inequality, and the Employment Relation", Mimeo. Columbia University.

[20] OECD [1996] : *Employment Outlook*, July 18.

[21] Park, K. [1997] : *The Korean American Dream : Immigrants and Small business in New York City*, Cornel University Press.

[22] Piketty, T. [1997]: "The Dynamics of Wealth Distribution and the Interest Rate with Credit Rationing", *Review of Economic Studies.*

[23] Quadrini, V. [1997] : "Entrepreneurship, saving and social mobility". Discussion Paper, FRB, Minneapolis.

[24] Saxenian, A. [1996] : "Beyond Boundaries : Open Labor Markets and Learning in Silicon Valley." in Arthur, M. B. and D. M. Rousseau, eds. *Occupations, Organizations, and Boundaryless Careers,* New York and Oxford: Oxford University Press, 1996.

[25] Stiglitz, J.M. and A. Weiss [1981]: "Credit Rationing in Markets with Imperfect Information", *American Economic Review,* 71:393-410

[26] Tocqueville, Alexis de [1835] : *Democracy in America.* Ed. P. Bradley, New York, 1945.

[27] Yoon, I-J. [1997] : *On My Own : Korean Businesses and Race Relations in America,* University of Chicago Press.

[28] Young, C. [1995] : "Financing the Micro-Scale Enterprise : Rural Craft Producers in Scotland, 1840-1914." *Business History Review,* Autumn.

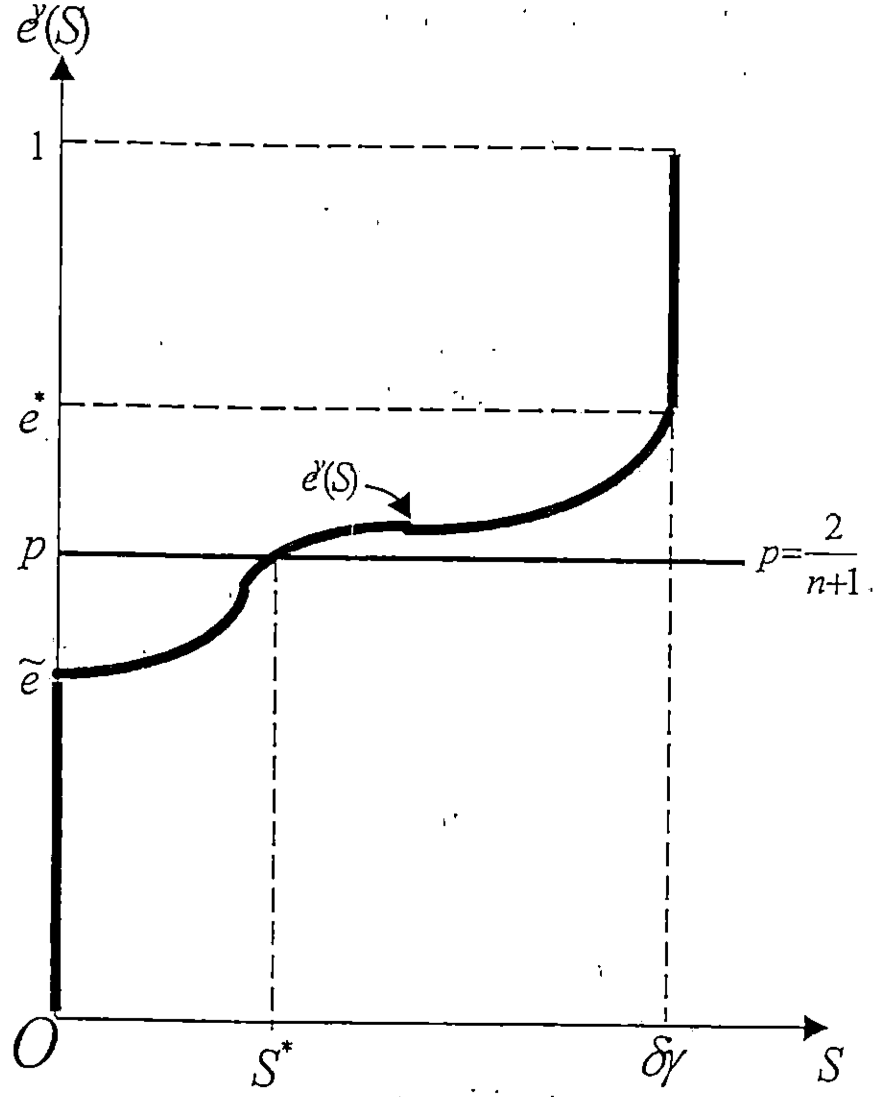

Figure 1

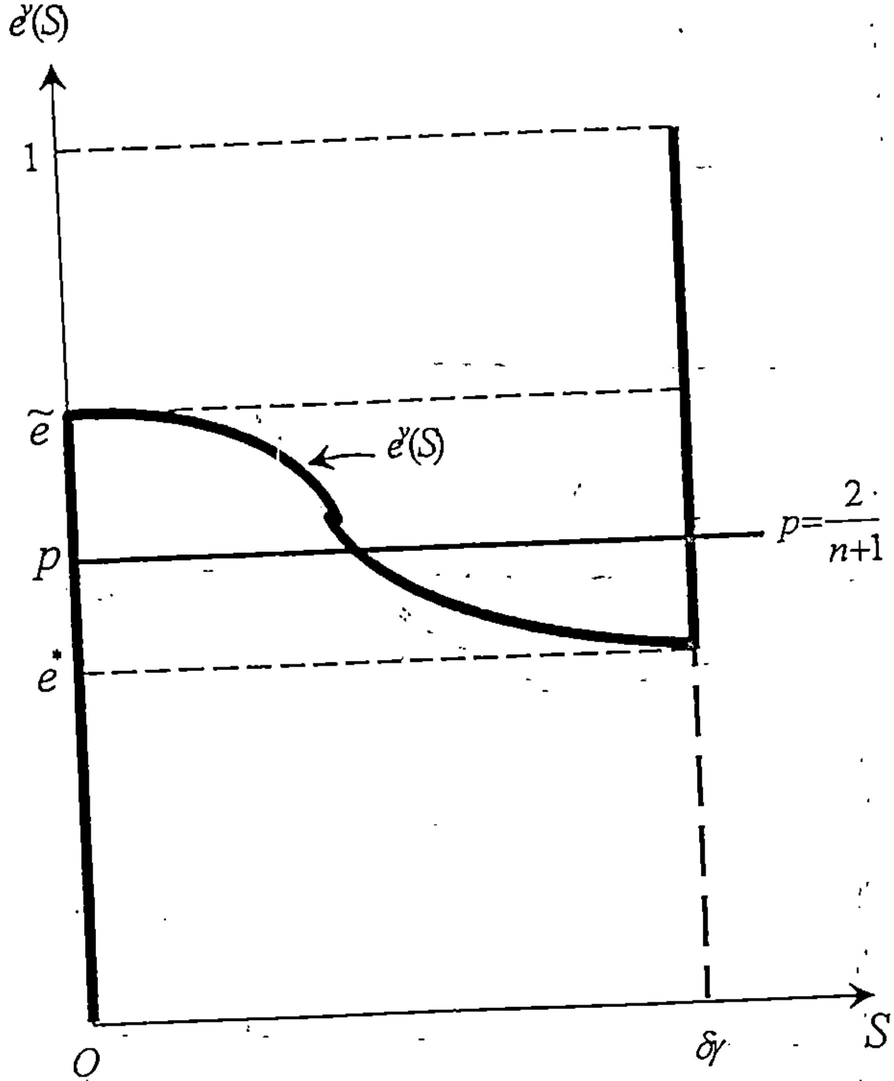

Figure 2

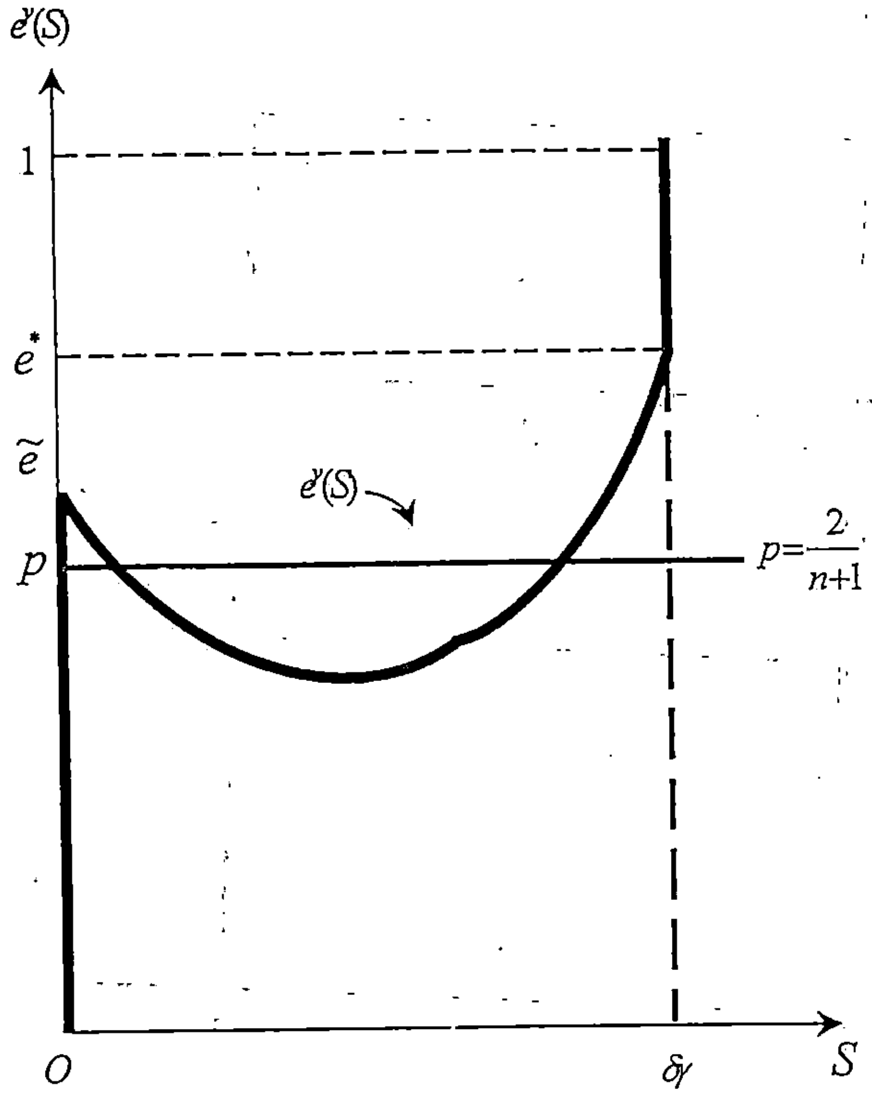

Figure 3

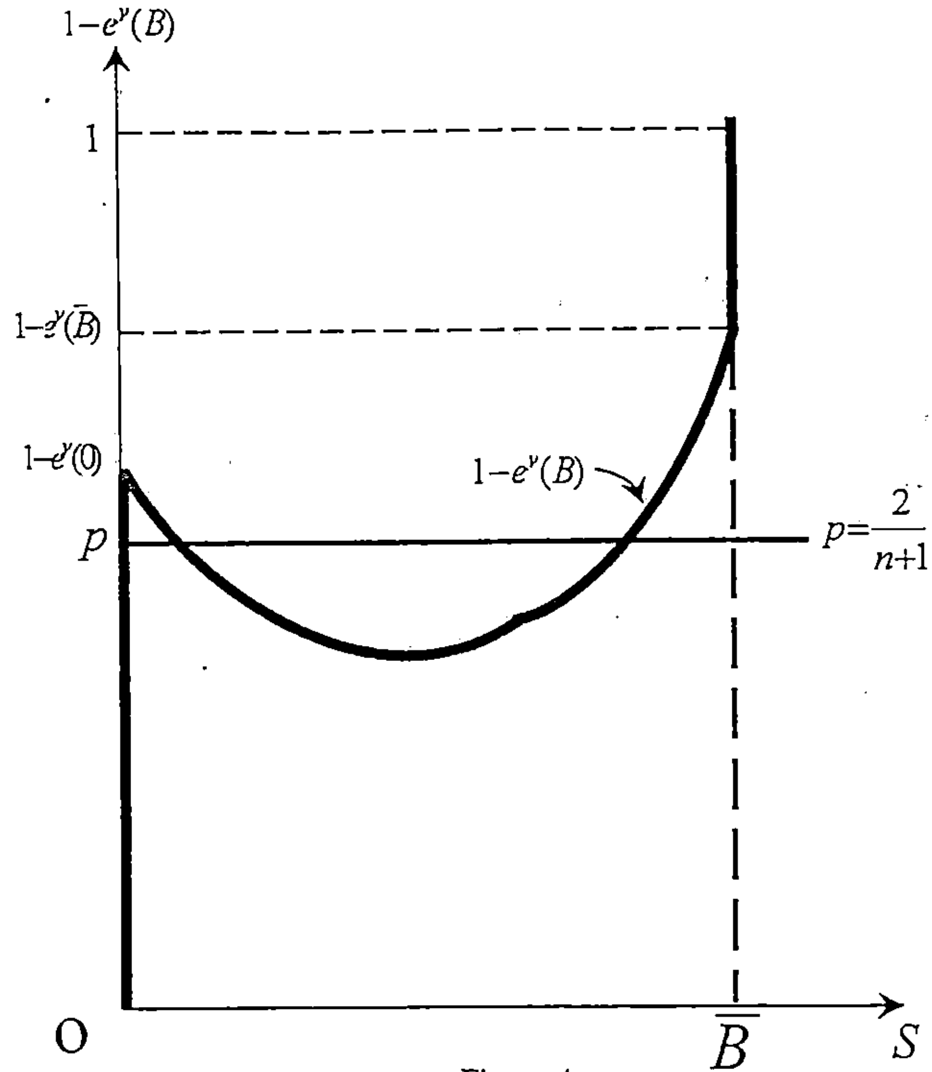
$1-e^{\gamma}(B)$
1
$1-e^{\gamma}(\bar{B})$
$1-e^{\gamma}(0)$
$1-e^{\gamma}(B)$
p
$p=\frac{2}{n+1}$
O
$\overline{B}$
S

Figure 4